Wave Statistics for the North Atlantic — 1970 to 1982

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Canadian Data Report Of Hydrography and Ocean Sciences

These reports provide a medium for the documentation and dissemination of data in a form directly useable by the scientific and engineering communities.

Generally, the reports will contain raw and/or analyzed data but will not contain interpretations of the data. Such compilations will commonly have been prepared in support of work related to the programs and interests of the Ocean Science and Surveys (OSS) sector of the Department of Fisheries and Oceans.

Data Reports are produced regionally but are numbered and indexed nationally. Requests for individual reports will be fulfilled by the issuing establishment listed on the front cover and title page. Out of stock reports will be supplied for a fee by commercial agents.

Regional and headquarters establishments of Ocean Science and Surveys ceased publication of their various report series as of December 1981. A complete listing of these publications and the last number issued under each title are published in the *Canadian Journal of Fisheries and Aquatic Sciences*, Volume 38: Index to Publications 1981. The current series began with Report Number 1 in January 1982.

Rapport statistique canadien sur l'hydrographie et les sciences océaniques

Ces rapports servent de véhicule pour la compilation et la diffusion des données sous une forme directement utilisable par les scientifiques et les techniciens.

En général, les rapports contiennent des données brutes ou analysées mais ne fournissent pas d'interprétations des données. Ces compilations sont préparées le plus souvent à l'appui de travaux reliés aux programmes et intérêts du service des Sciences et Levés océaniques (SLO) du ministère des Pêches et des Océans.

Les rapports statistiques sont produits à l'échelon régional mais sont numérotés et placés dans l'index à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page de titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Les établissements des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports depuis décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du Rapport n° 1 en janvier 1982.

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by

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ABSTRACT

Walker, R.E. 1984. Wave Statistics for the North Atlantic - 1970 to 1982. Can. Data Rep. Hydrogr. Ocean Sci. 16: iv + 291 p.

Monthly wave height distributions of a 13 year (1970-1982) time series of wave data charts issued every 12 hours for the North Atlantic are presented. Also included are the combined 13 year wave height distributions.

The graphs presented have been expanded to permit extrapolation of the distribution to the 100 year probability value.

RÉSUMÉ

Walker, R.E. 1984. Wave Statistics for the North Atlantic - 1970 to 1982. Can. Data Rep. Hydrogr. Ocean Sci. 16: iv + 291 p.

On présente les répartitions mensuelles de la hauteur des vagues pendant une période de 13 ans (1970-1982 à partir de cartes émises chaque 12 heures) des données sur les vagues dans l'Atlantique-Nord. L'étude fournit également les répartitions combinées de la hauteur des vagues pour les 13 années.

On présente des courbes qui ont été prolongées afin de permettre l'extrapolation de la répartition jusqu'à la valeur probable pour 100 ans.

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INTRODUCTION

This report is the fourth in the Bedford Institute of Oceanography data series "Wave Climate of the North Atlantic" (see Walker, 1976; Walker, 1977 and Walker, 1978) which is based on a continuous time series from 1970 to 1982.

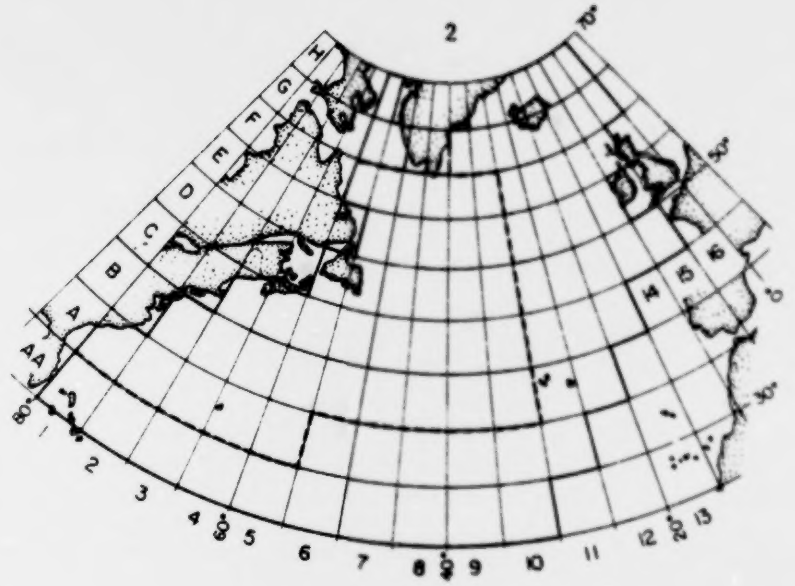
WAVE DATA CHARTS

The data are derived from wave charts issued twice daily by the Canadian Forces Meteorological and Oceanographic Centre (METOC) in Halifax, N.S. These charts are based upon synoptic visual observations of waves from ships at sea and on data from weather ships and oil exploration/ drilling rigs equipped with wave recorders.

As argued by Neu (1982) these waves reported are for all practical purposes significant waves, that is, their height is the mean of the highest one-third of all the waves during the observation, and their reported periods are about 10% less than the mean period of these one-third highest waves.

The study area from which the data were collected lies between latitudes 25 N and 70 N. Not included were the marginal seas, ocean embayments and the shallow areas of the coastal region in which waves are affected by shoaling, refraction and diffraction. The area around the Canary Islands was not included due to the scarcity of wave observations reported to METOC.

The study area is comprised of eighty-eight 5°x5° areas which include regions in coastal waters where the shore line infringes some grid areas. The entire study area is enclosed by a solid line shown in Figure 1.



WAVE HEIGHT

CODE	HEIGHT (m)
1	0.5 — 1.4
2	1.5 — 2.4
3	2.5 — 3.4
4	3.5 — 4.4
5	4.5 — 5.4
6	5.5 — 6.4
7	6.5 — 7.4
8	7.5 — 8.4
9	8.5 — 9.4
10	9.5 — 10.4
etc.	

8 POINT DIRECTION SYSTEM

WAVE PERIOD

CODE	T(S)
3	0 — 3.4
4	3.5 — 4.4
5	4.5 — 5.4
6	5.5 — 6.4
7	6.5 — 7.4
8	7.5 — 8.4
9	8.5 — 9.4
10	9.5 — 10.4
11	10.5 — 11.4
12	11.5 — 12.4
etc	

NOTES: Direction - from which waves are coming.
Height - vertical distance from crest to trough.
Period - interval required for successive crests or troughs to pass a fixed point.

Figure 1. BIO Grid System and Code of Wave Properties

As observations of periods and directions of the waves reported in the METOC charts were less frequent in the eastern North Atlantic than in the western North Atlantic, reading of these properties was restricted to the thirty-nine 5°x5° areas of the western North Atlantic. This region is outlined by the dashed line shown in Figure 1.

DATA PRESENTATION

In this report only the wave heights are presented. They are plotted by areas and months and by areas and years. The original data, which include periods and directions for the western North Atlantic, are on file at B.I.O. and may be obtained upon request.

DATA READING

Wave height, period and direction were read at the centre of the 5° area. The height was determined to the nearest metre. The period was read in seconds while the direction was read in one of the eight 45° sectors, with the north sector extending from 337.5° to 22.5°.

When sea ice cover was in excess of 50% of an area's surface it was assumed that there were no waves.

DATA SORTING

For this report, data have been sorted by height for each area and then grouped by month and by year for a complete time series for each of the 88 areas, 1970 through 1982. The number of observations was 9496.

DISTRIBUTION PLOTS

Each probability x logarithmic graph has been expanded to permit extrapolation of the distribution plots to the 100 year extreme value of wave heights. Values of the 100 year lines are as follows:

Percentage Exceedance	Date Series	Probability
0.01613	13 years	99.99863
0.01667	31 day months	99.98387
0.01777	30 day months	99.98333
0.00137	28 day months	99.98223

ACKNOWLEDGEMENT

I would like to thank the ship-borne observers who have shown considerable care and consistency in their reports and the staff of the Canadian Forces METOC Centre in Halifax, Nova Scotia who have maintained the quality control that has been vital to this report.

REFERENCES

NEU, H.J.A. 1982. 11-year Deep-Water Wave Climate of Canadian Atlantic Waters. Canadian Technical Report of Hydrography and Ocean Sciences No. 13, 1982.

WALKER, R.E. 1976. Wave Statistics for the North Atlantic - 1970. Bedford Institute of Oceanography, Data Series BI-D-76-3, Dartmouth, N.S.

WALKER, R.E. 1977. Wave Statistics for the North Atlantic - 1970. Bedford Institute of Oceanography, Data Series BI-D-77-1, Dartmouth, N.S.

WALKER, R.E. 1978. Wave Statistics for the North Atlantic - 1972. Bedford Institute of Oceanography, Data Series BI-D-78-2, Dartmouth, N.S.

DISTRIBUTION PLOTS

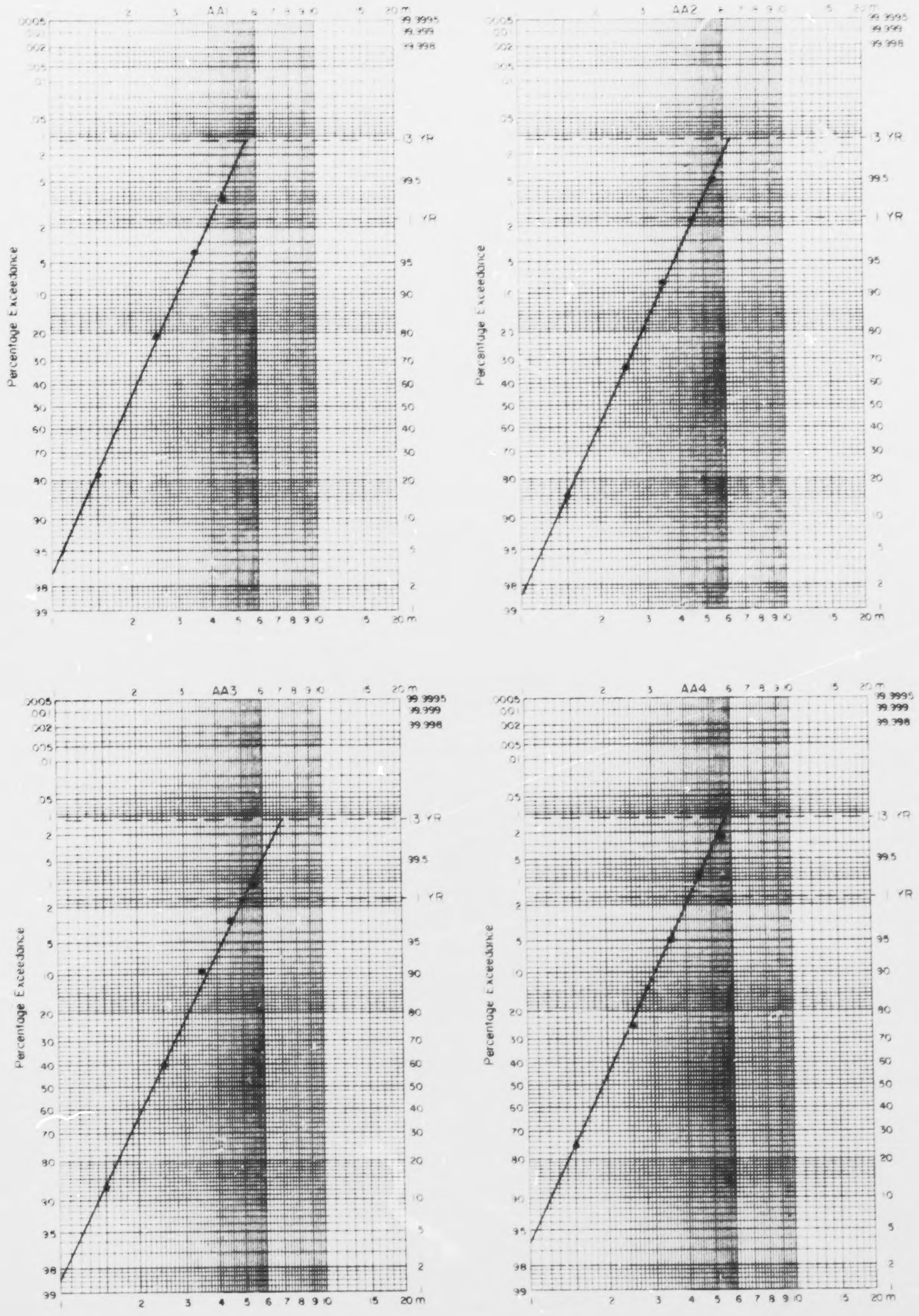


Figure 1a   Monthly Wave Height Exceedance Distribution for January

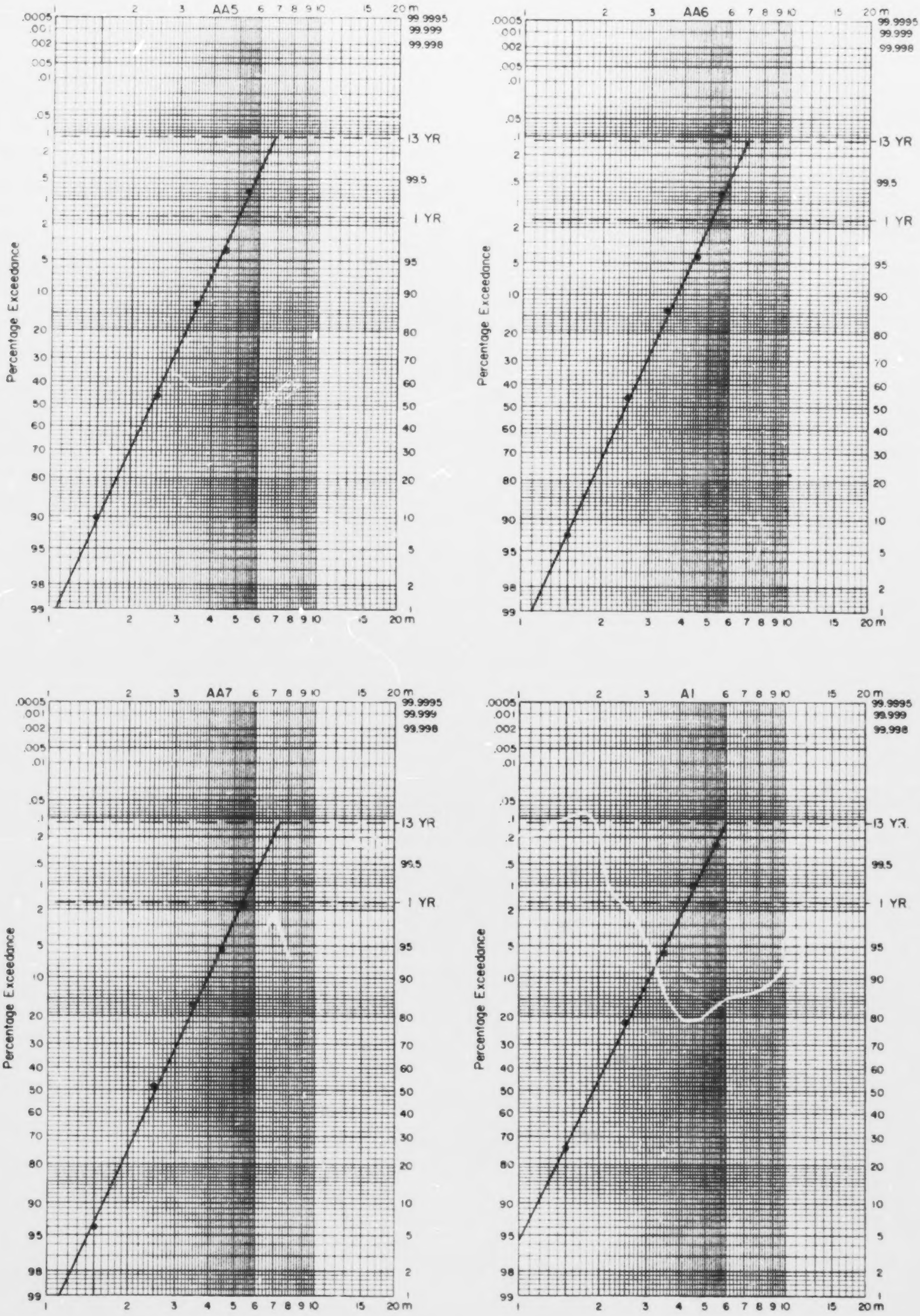


Figure Ib. Monthly Wave Height Exceedance Distribution for January

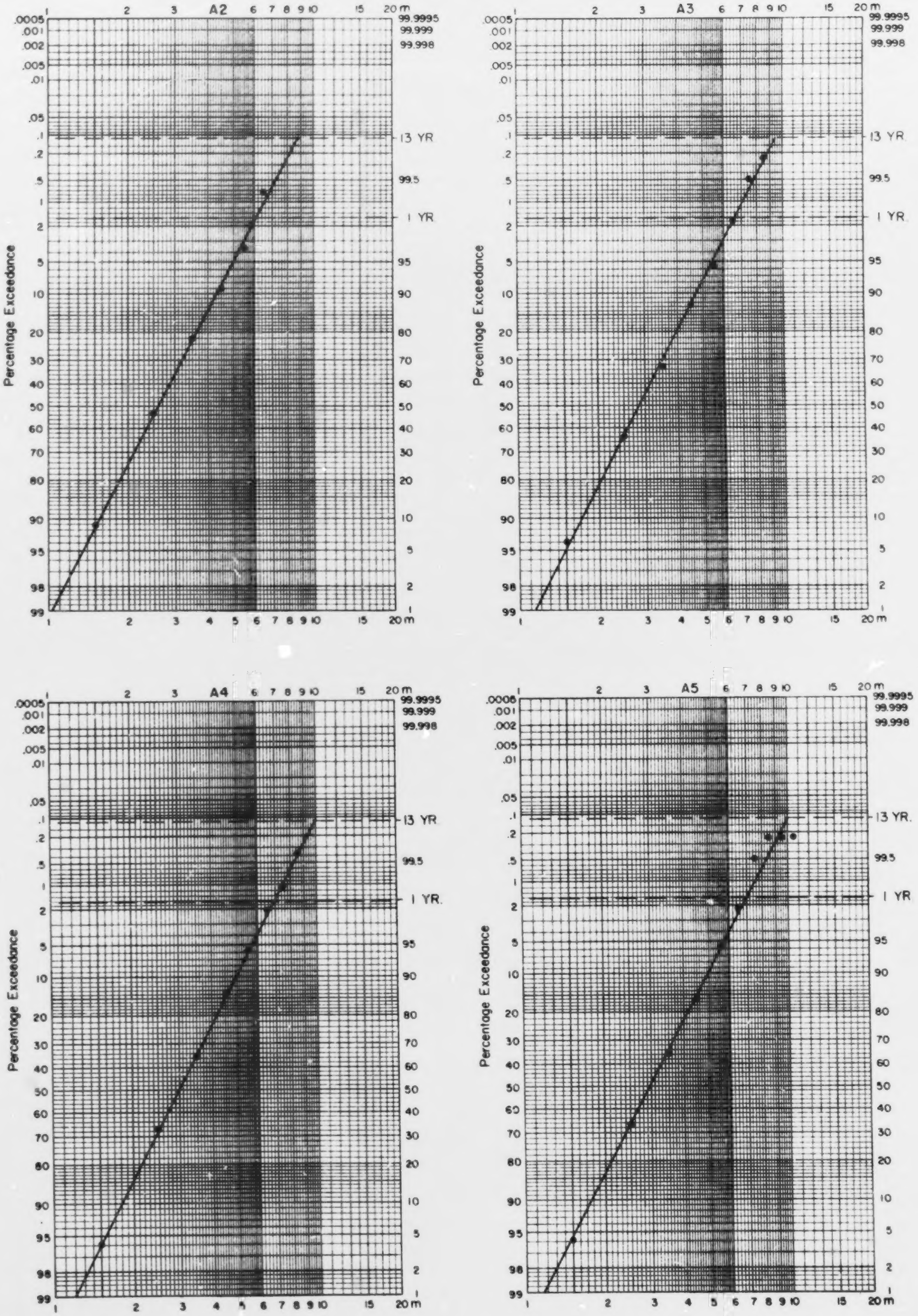


Figure Ic. Monthly Wave Height Exceedance Distribution for January

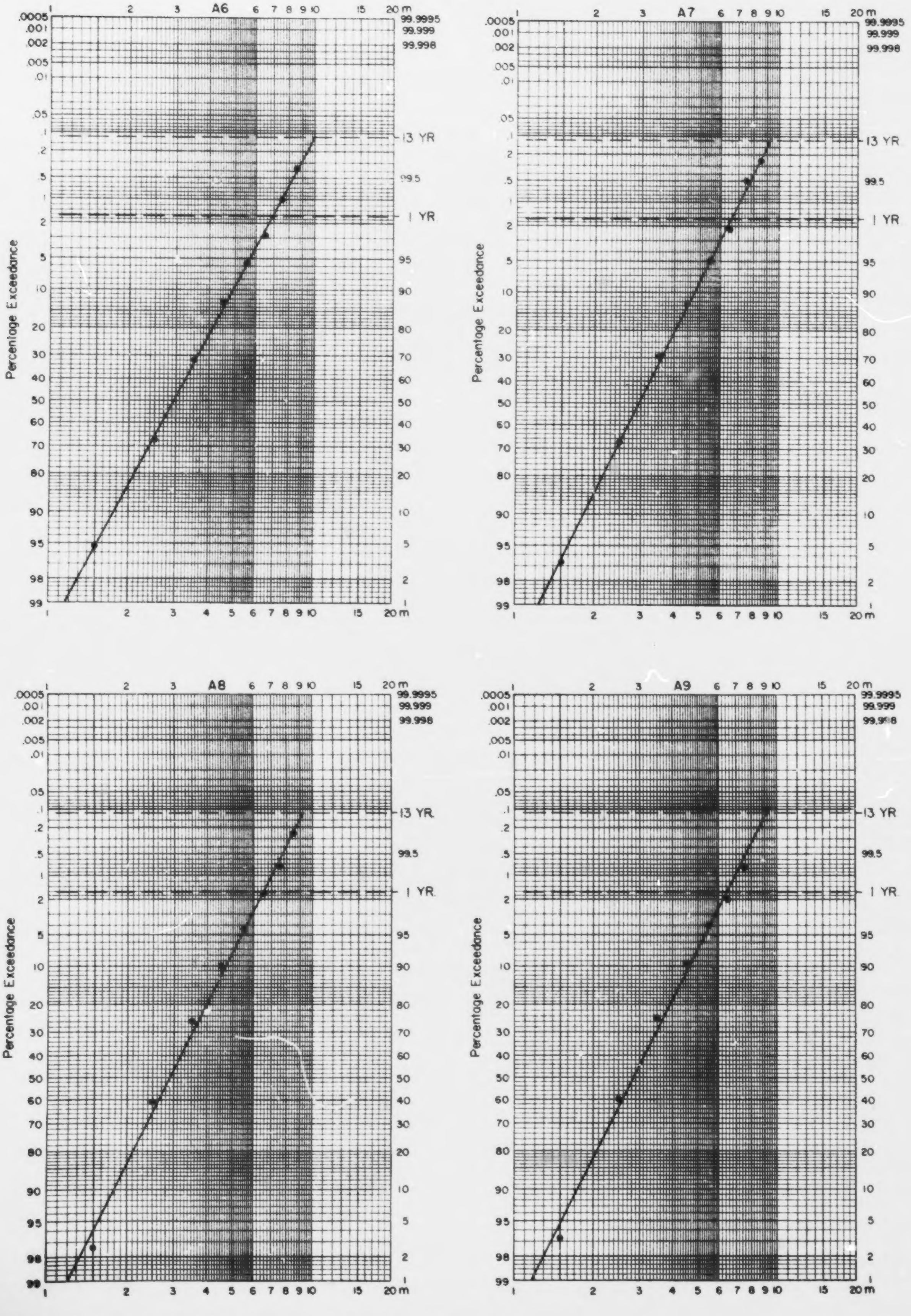
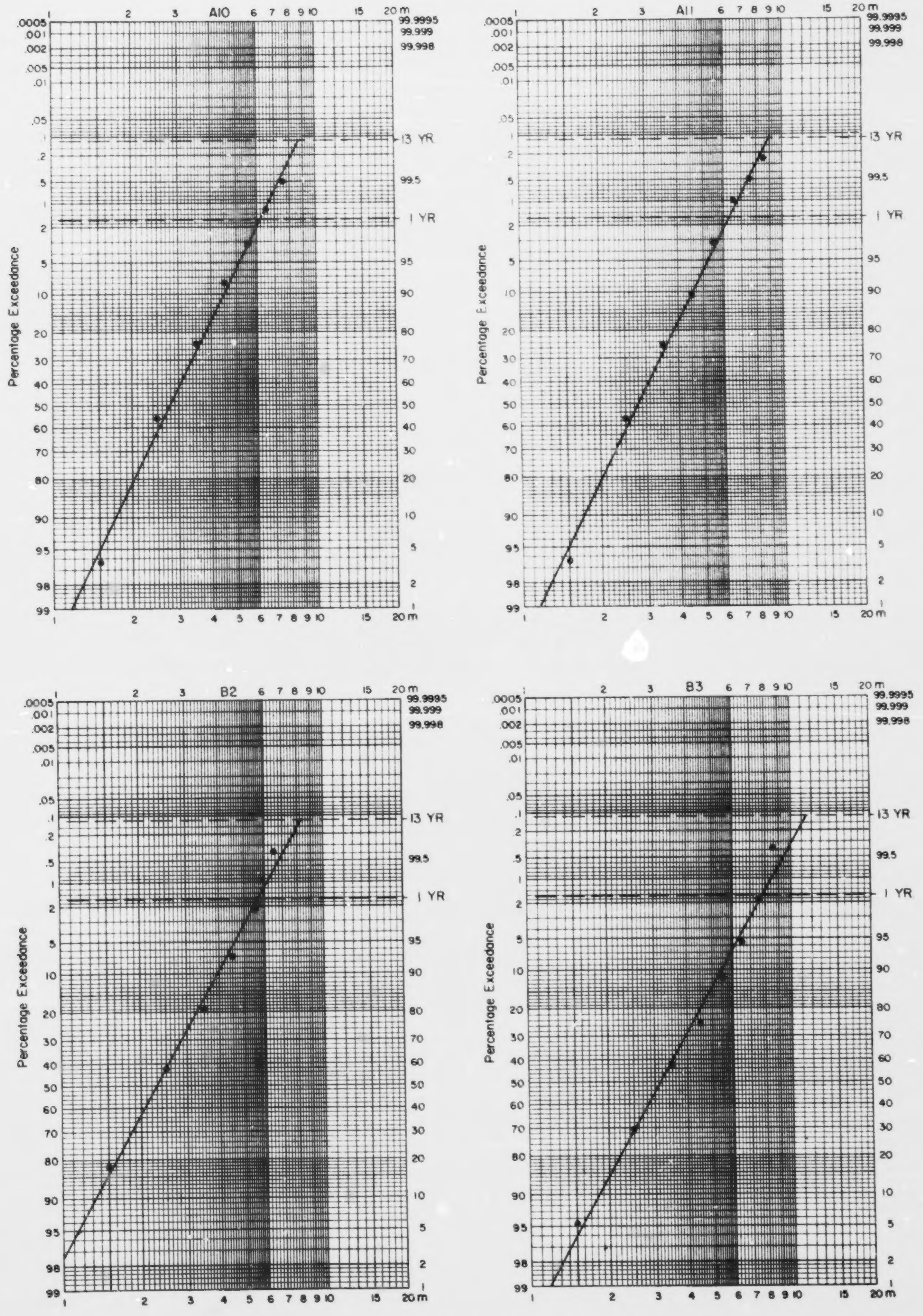


Figure Id. Monthly Wave Height Exceedance Distribution for January



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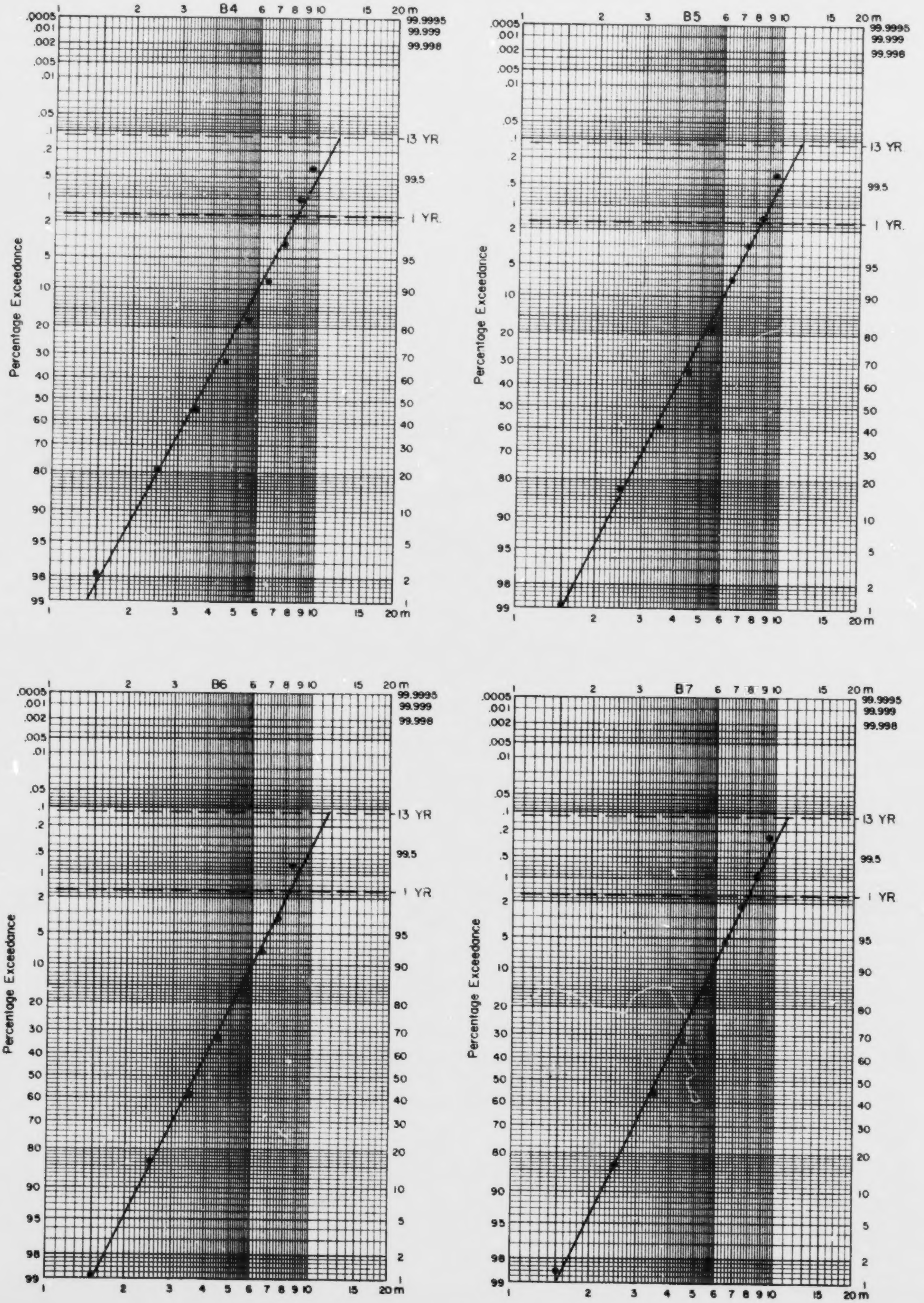
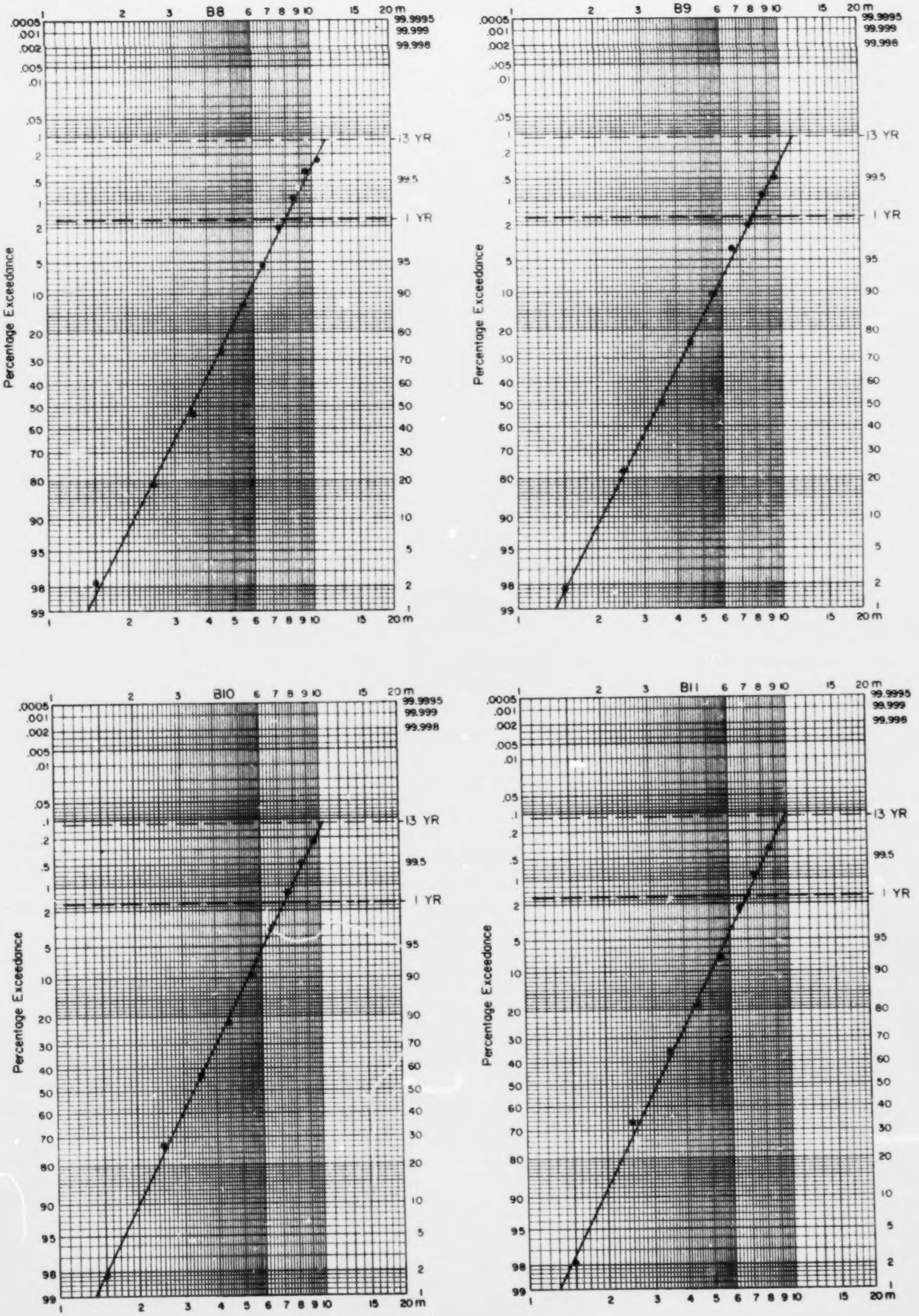


Figure 11. Monthly Wave Height Exceedance Distribution for January



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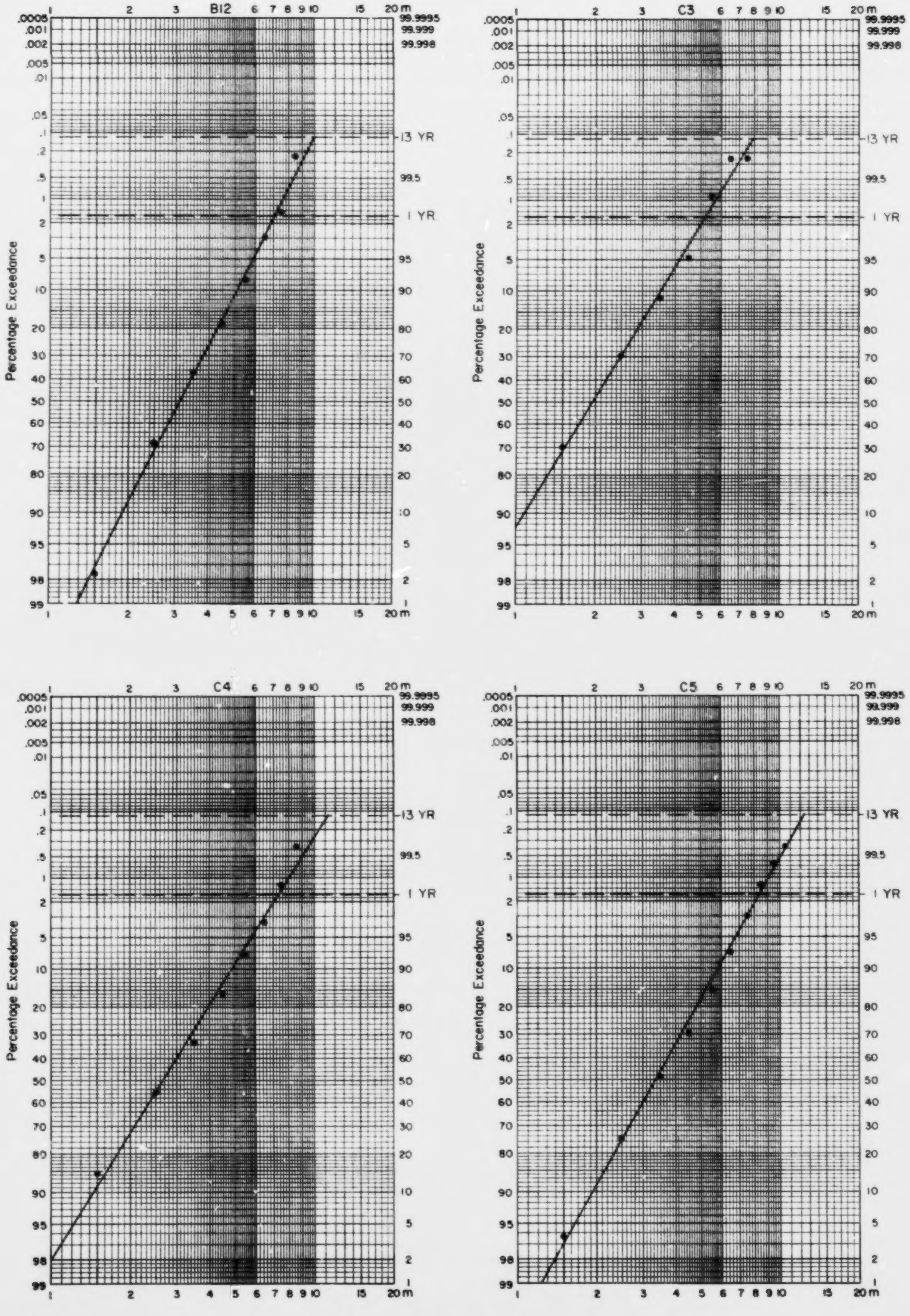

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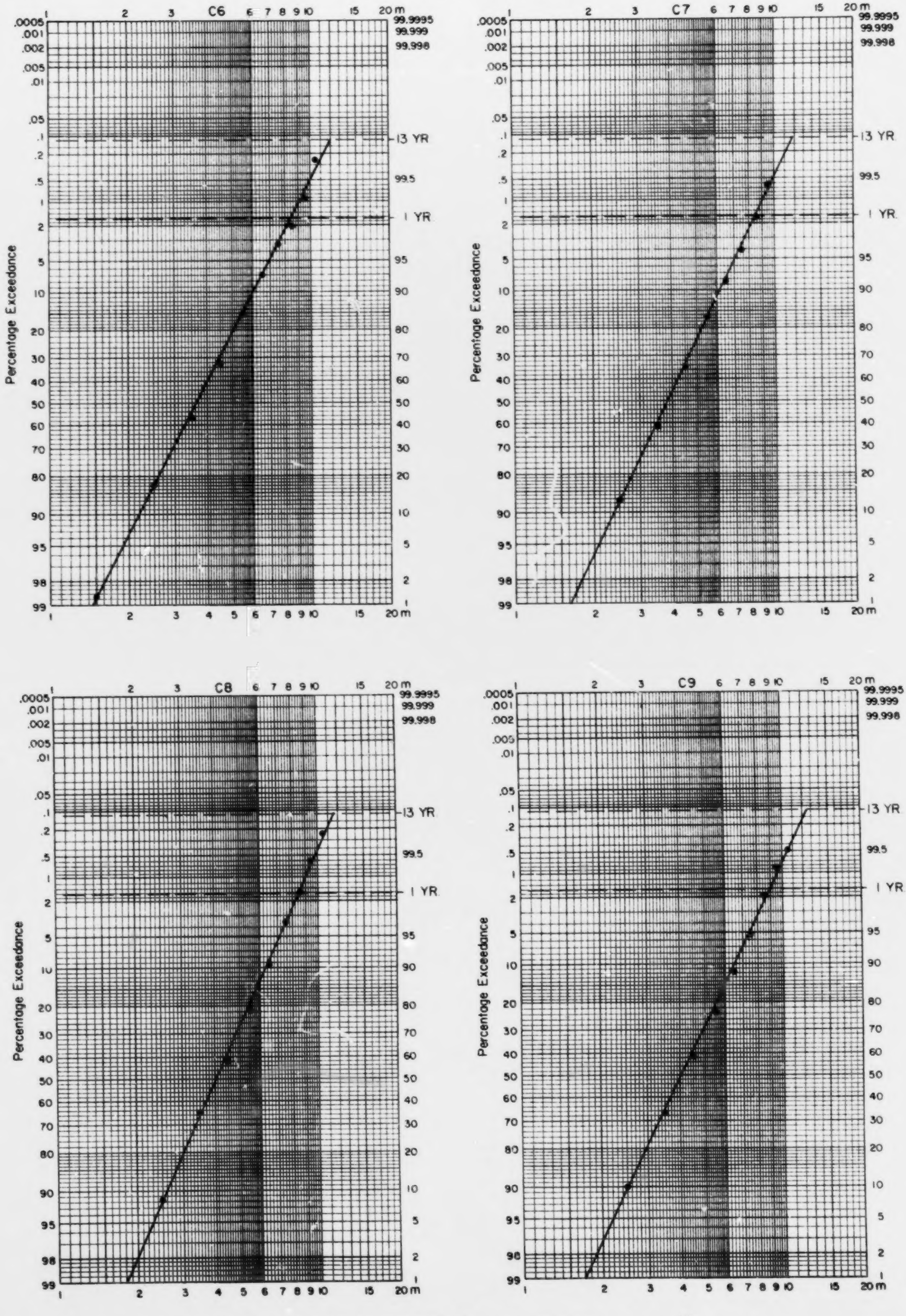

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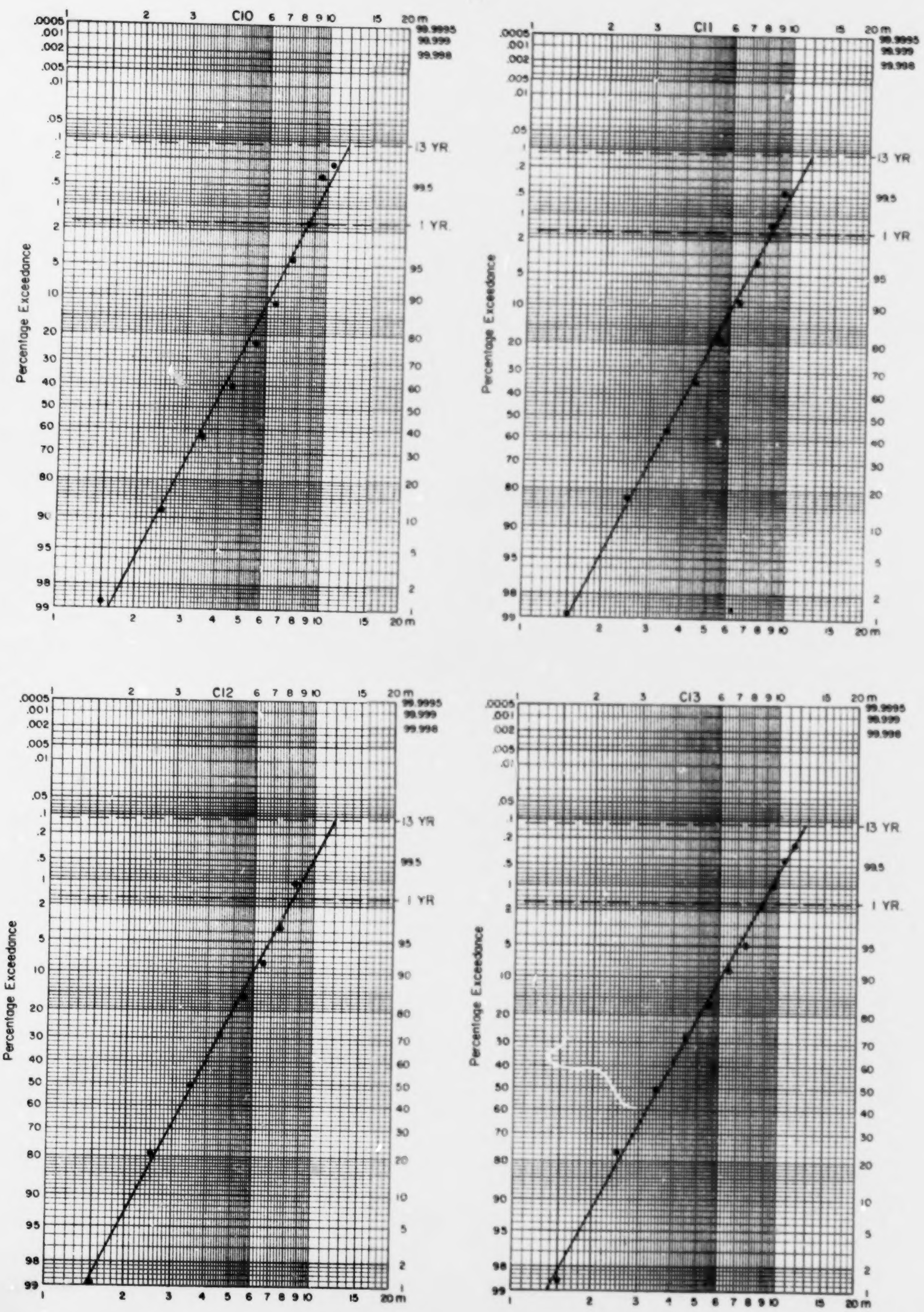

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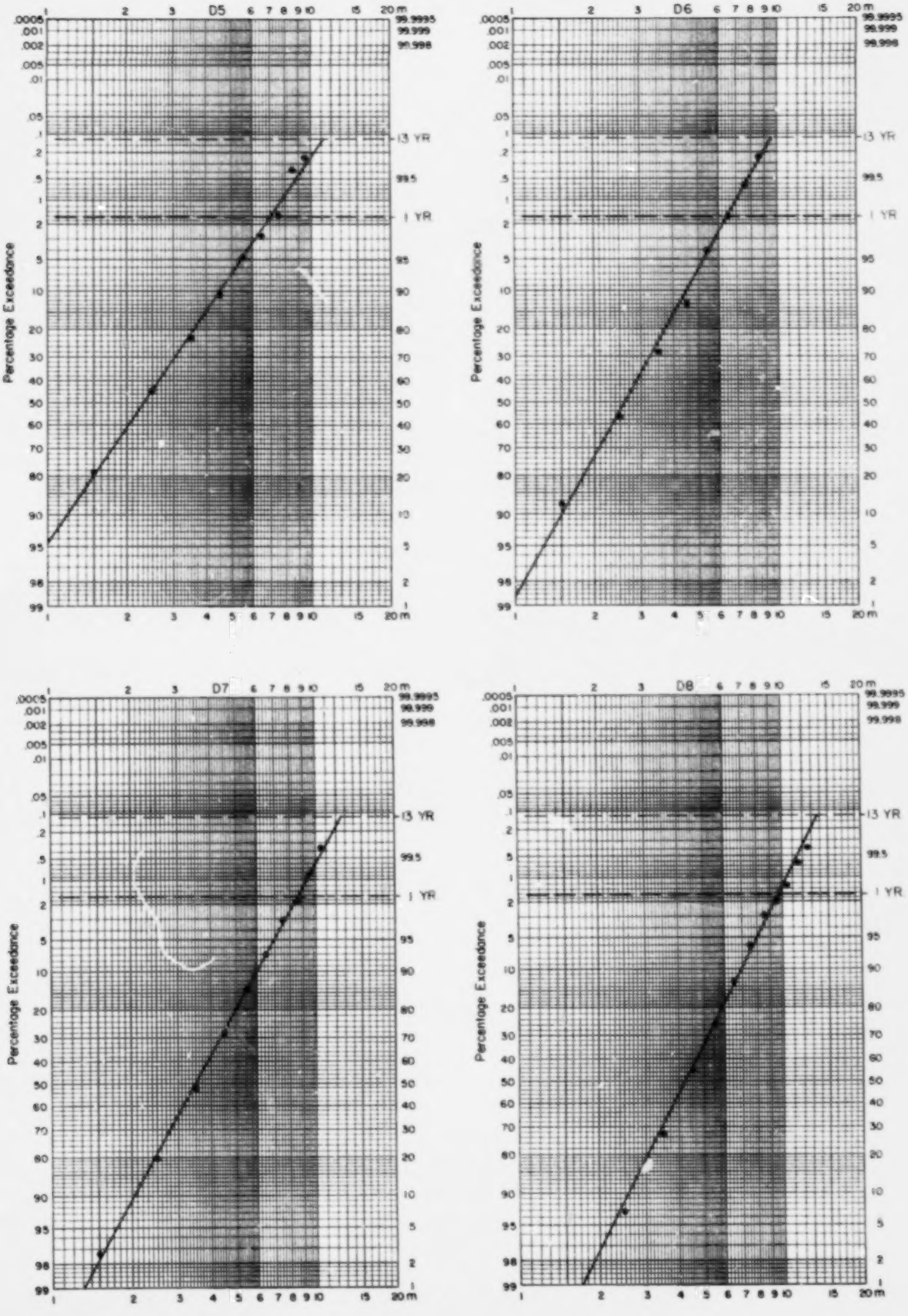

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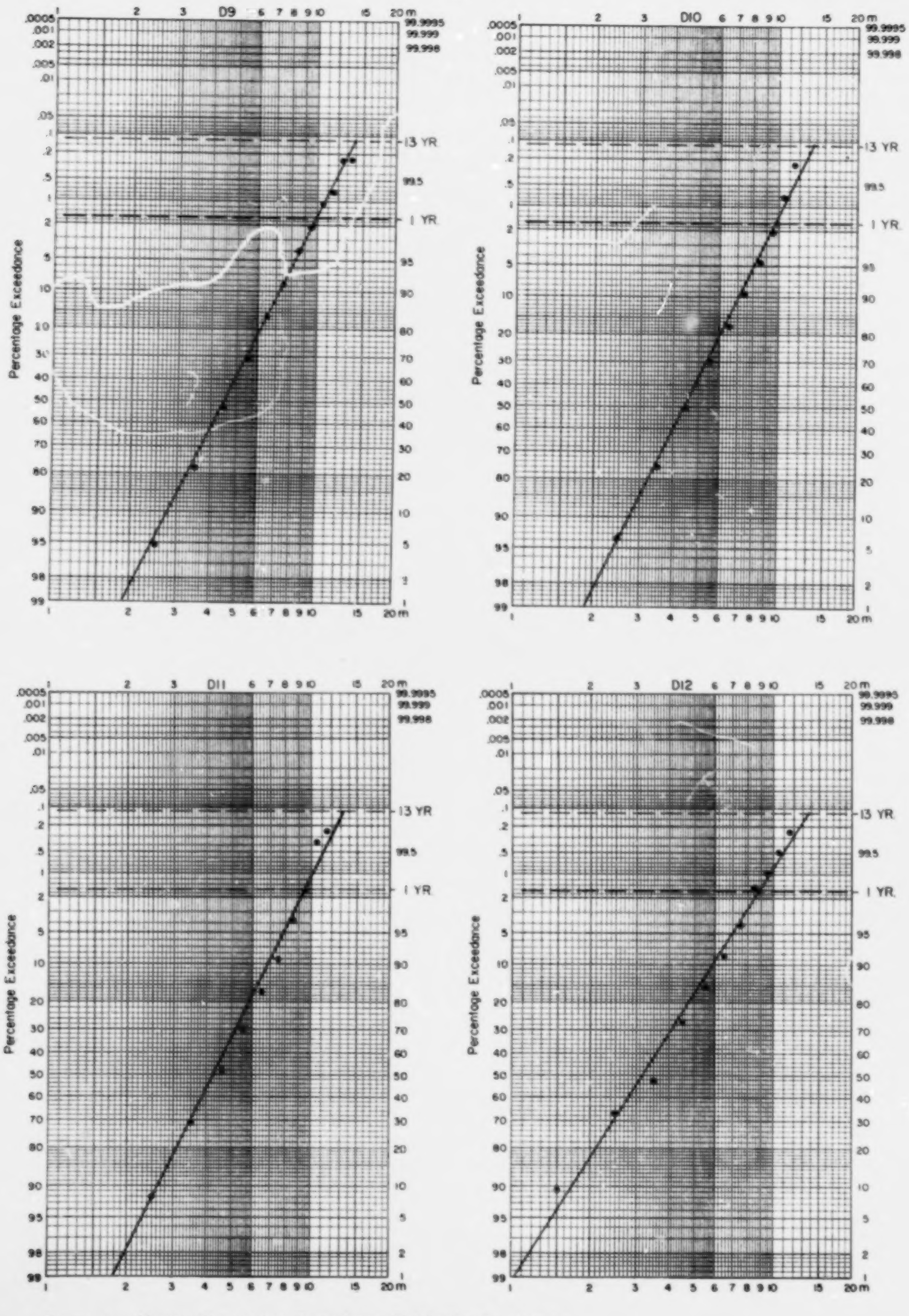

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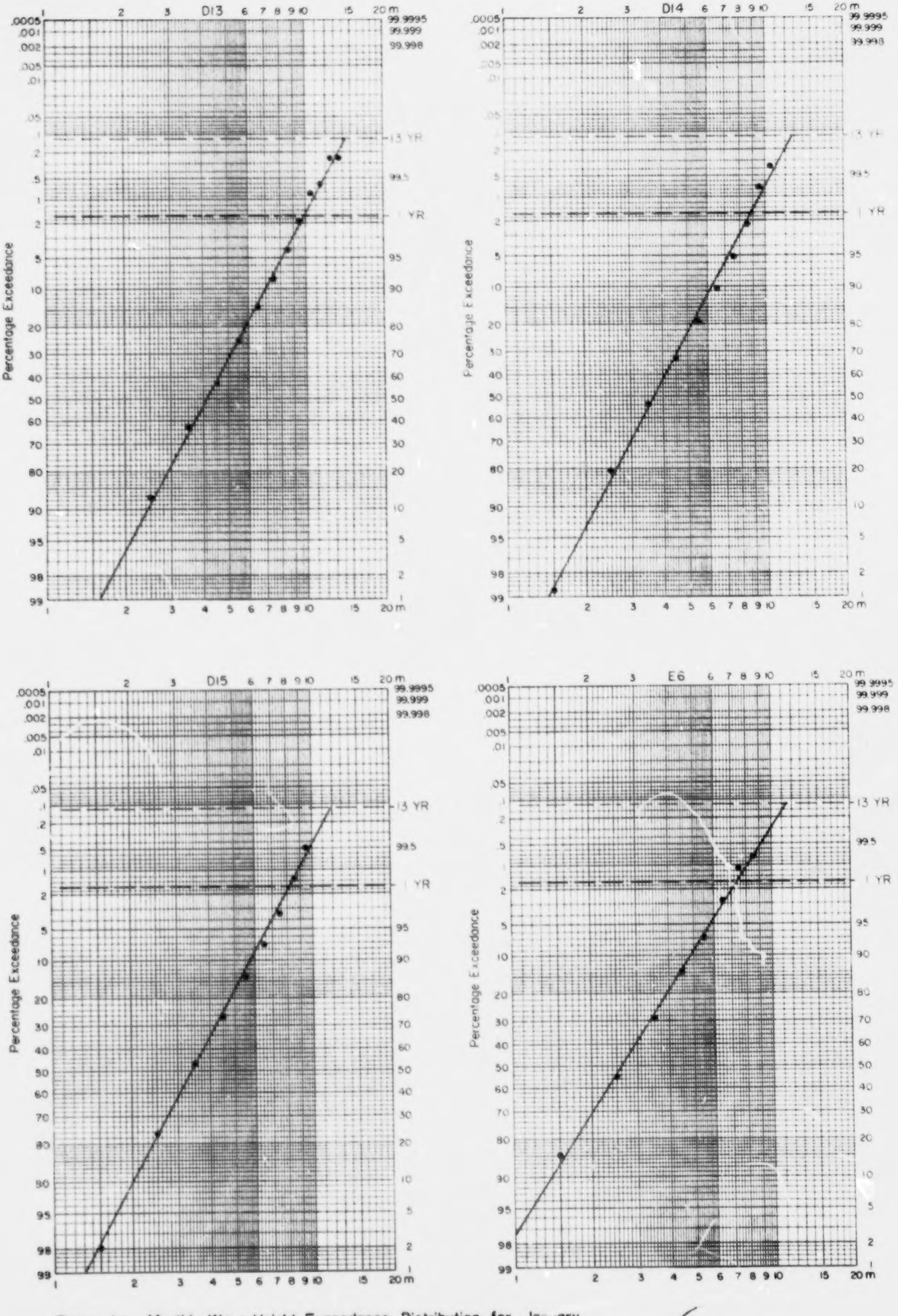

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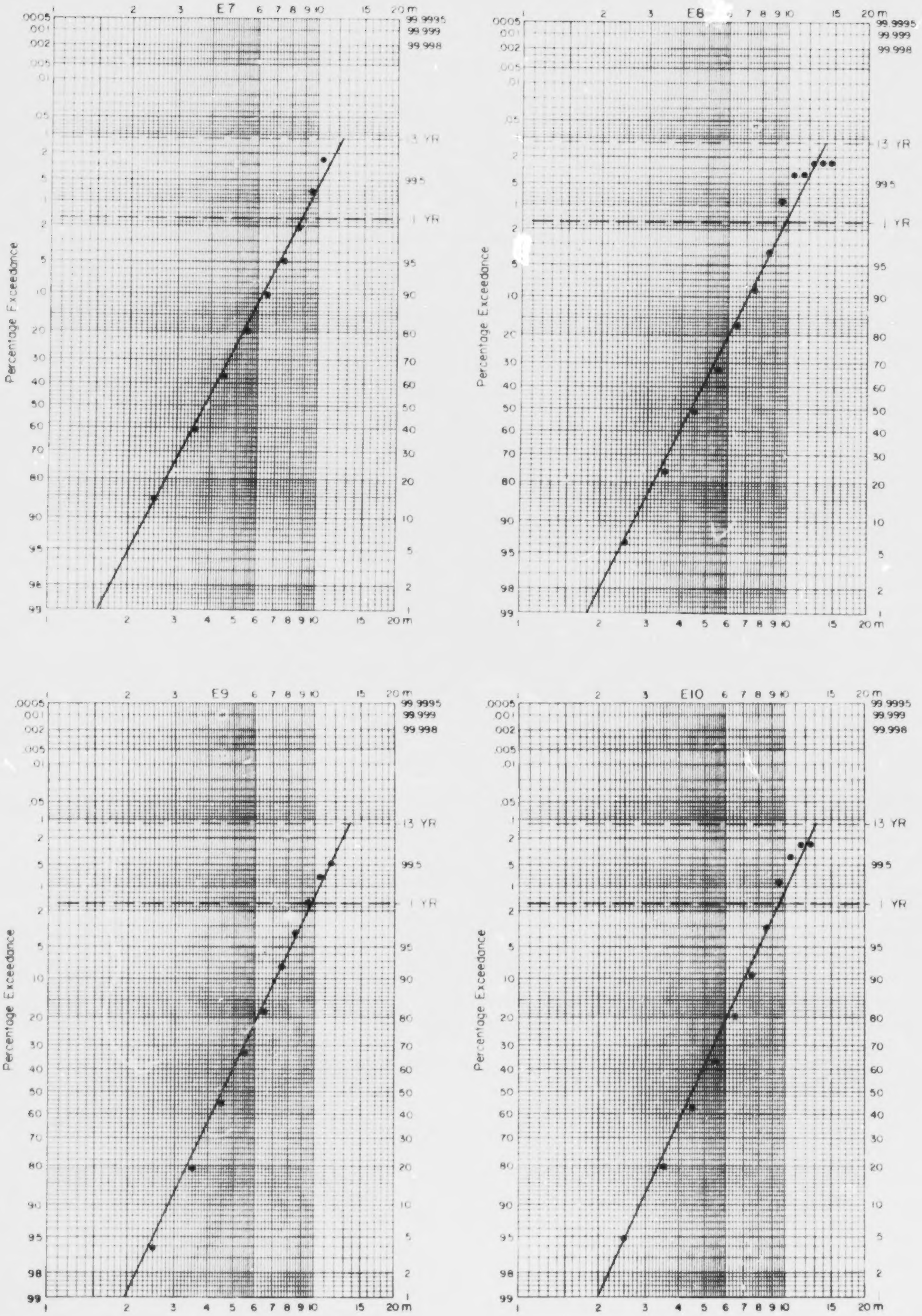

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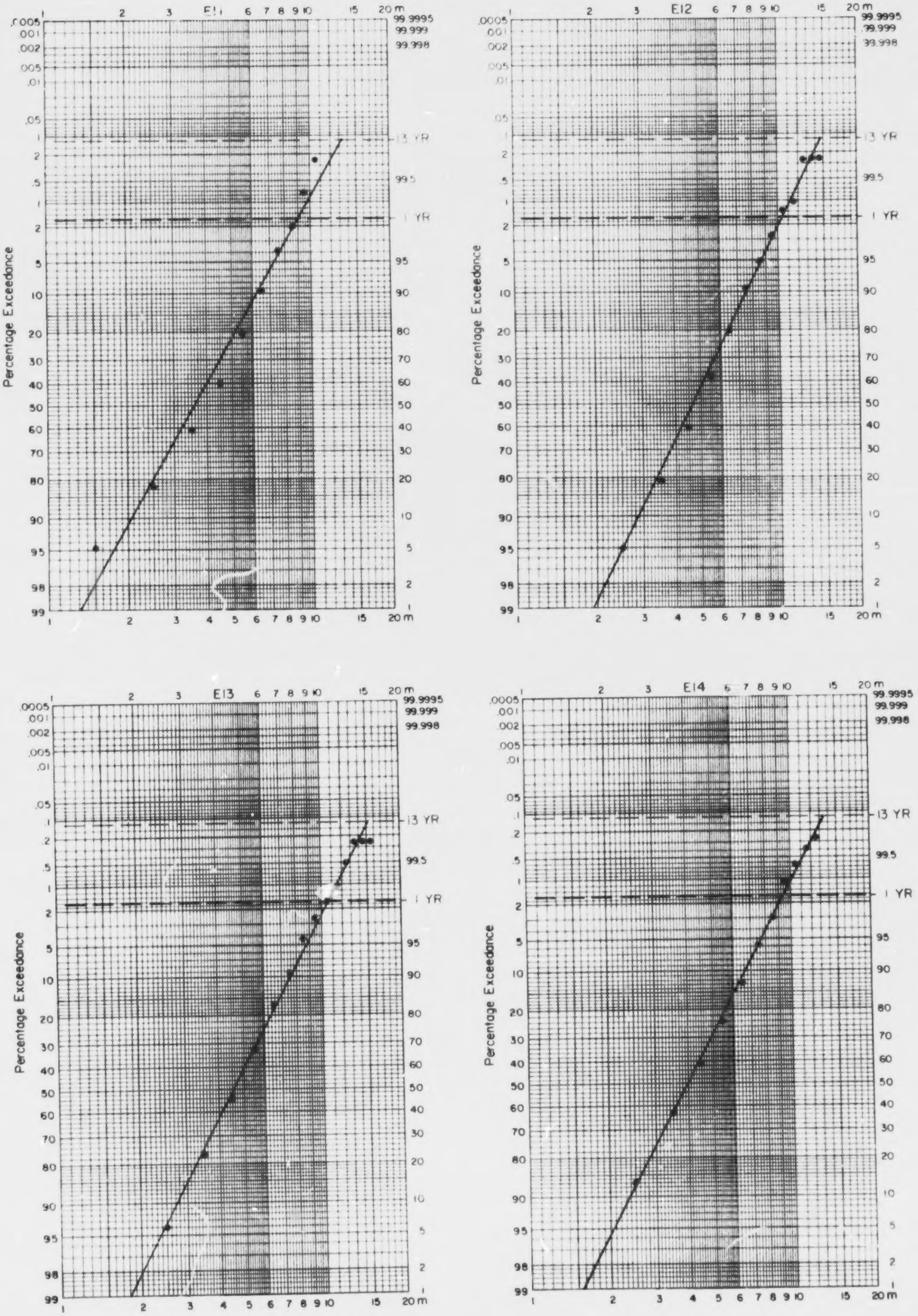

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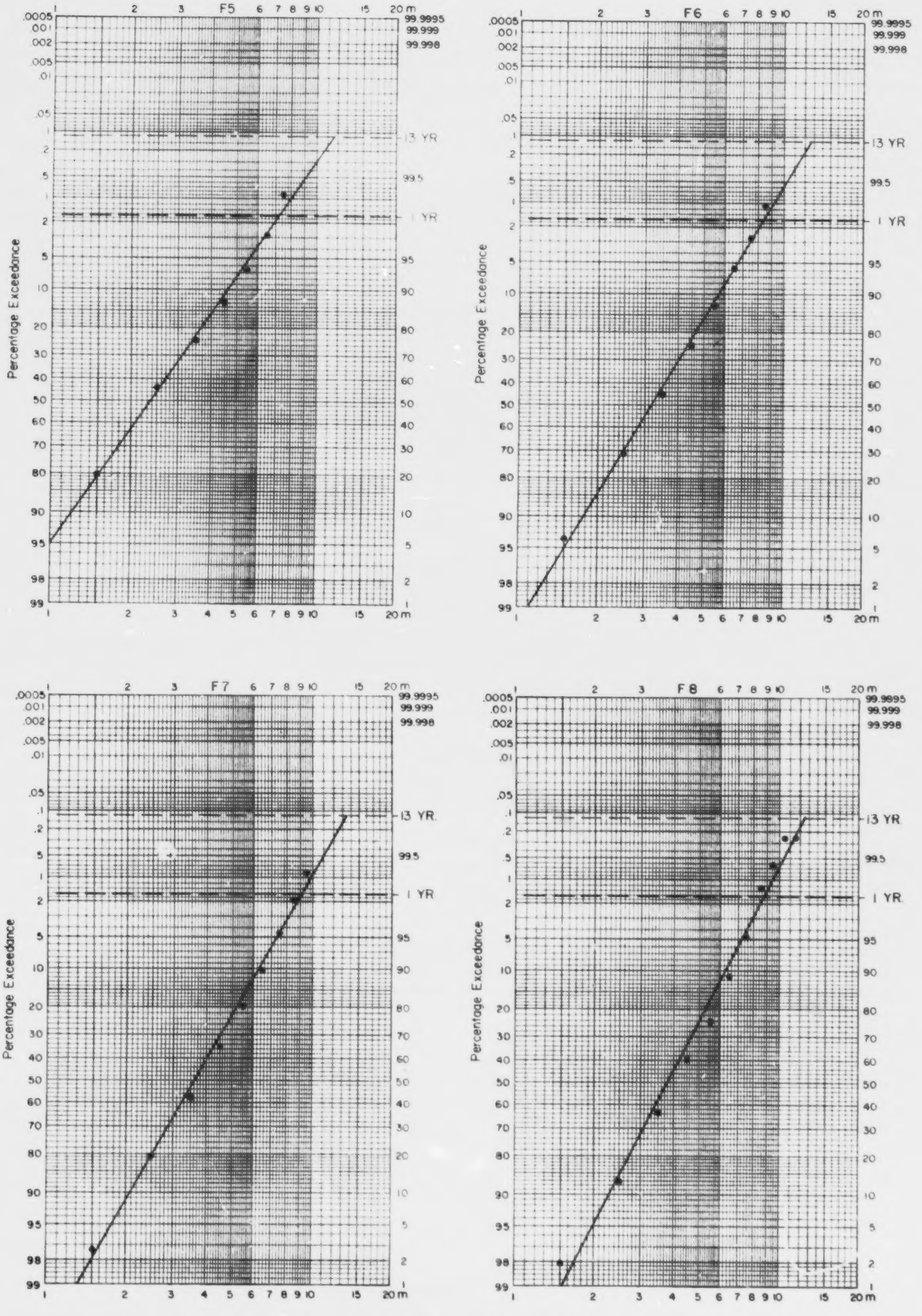

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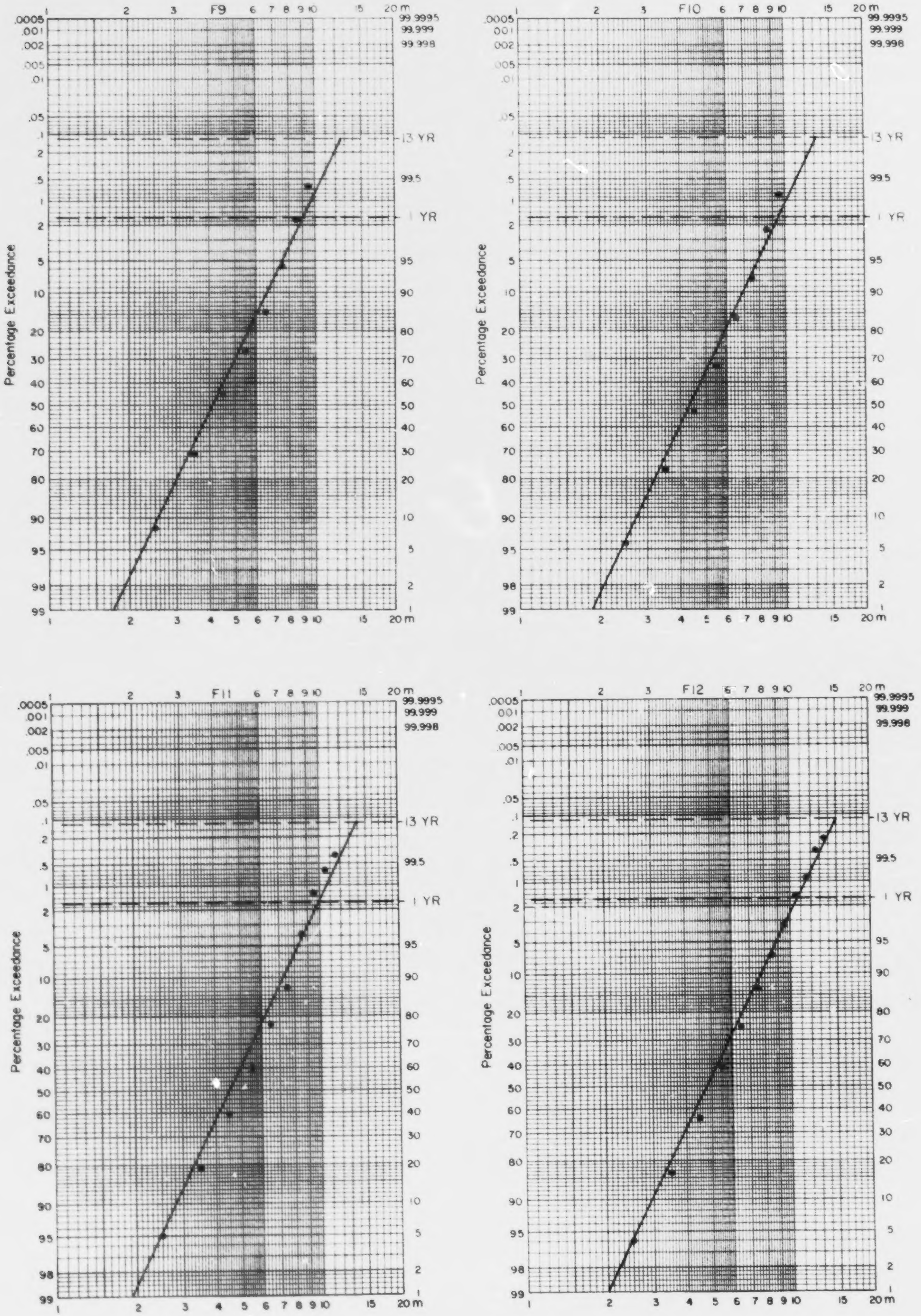

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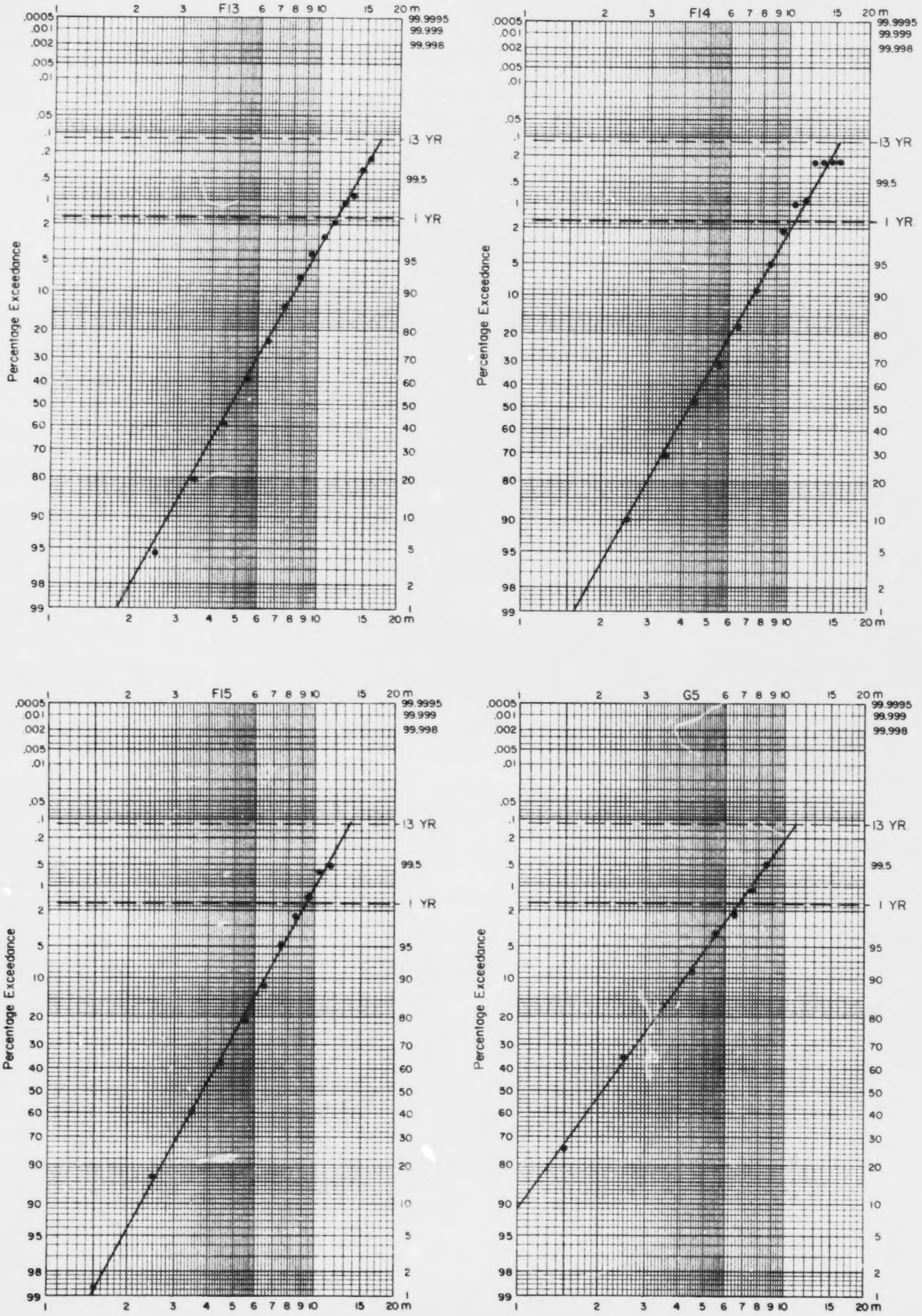

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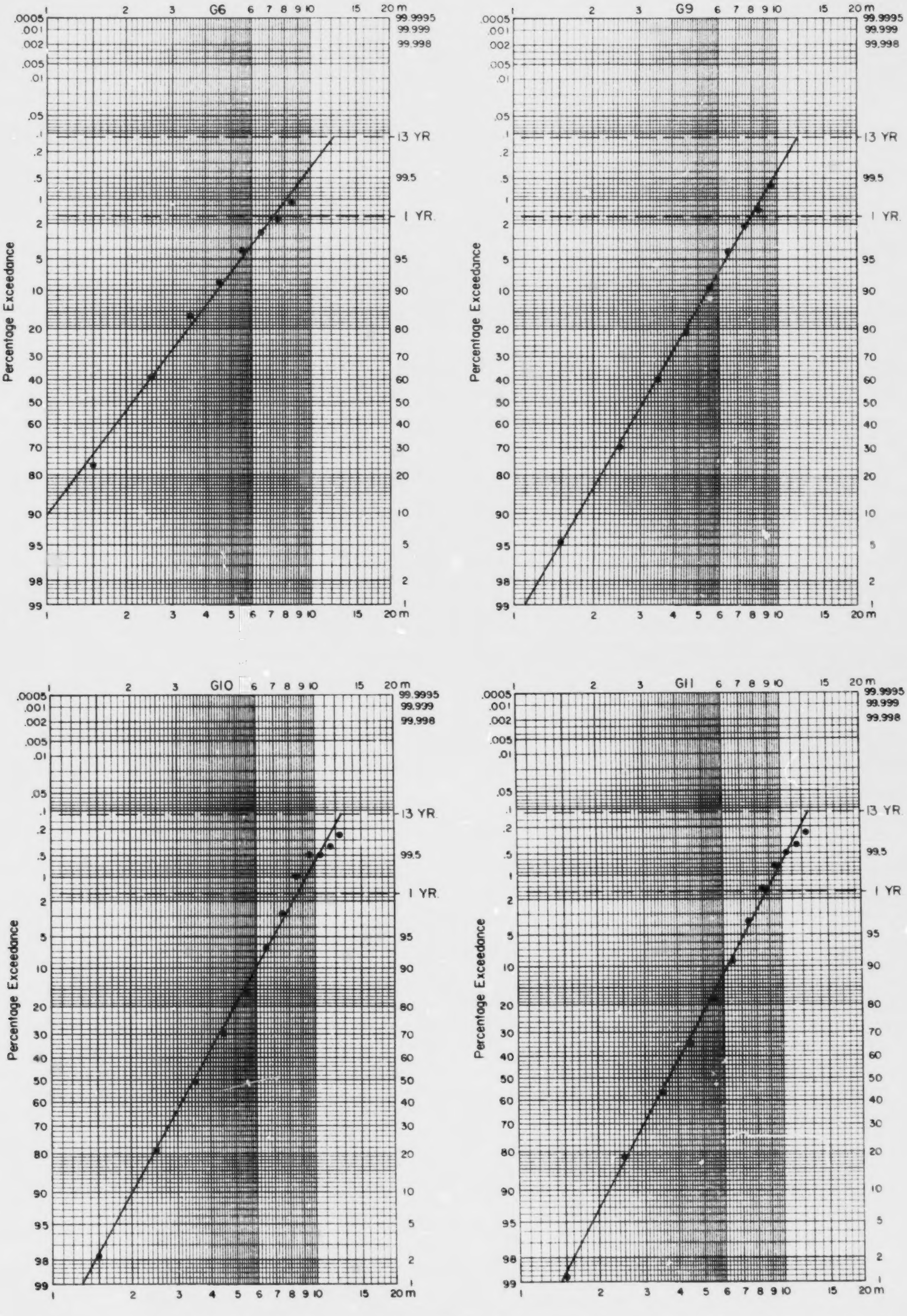

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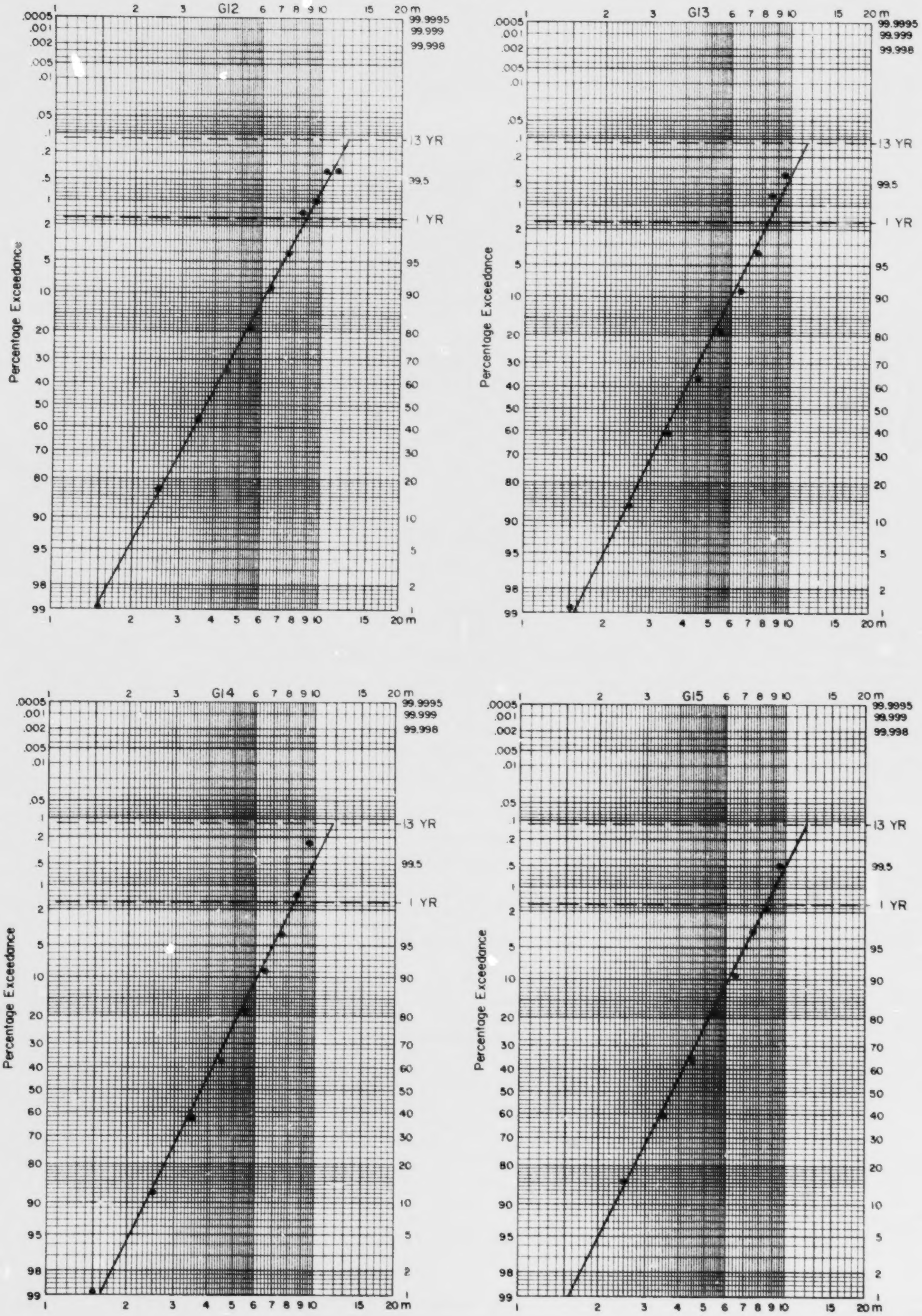

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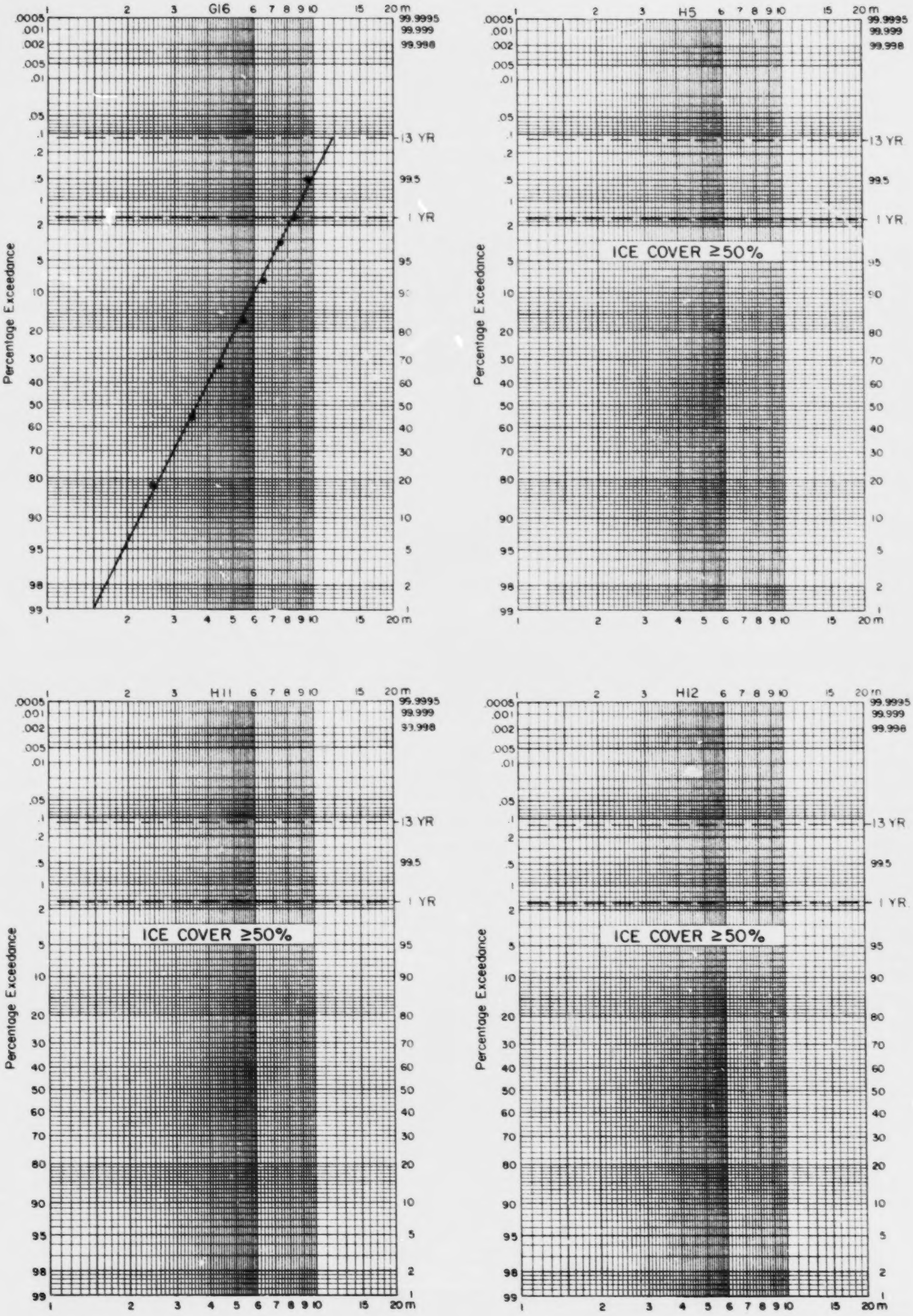
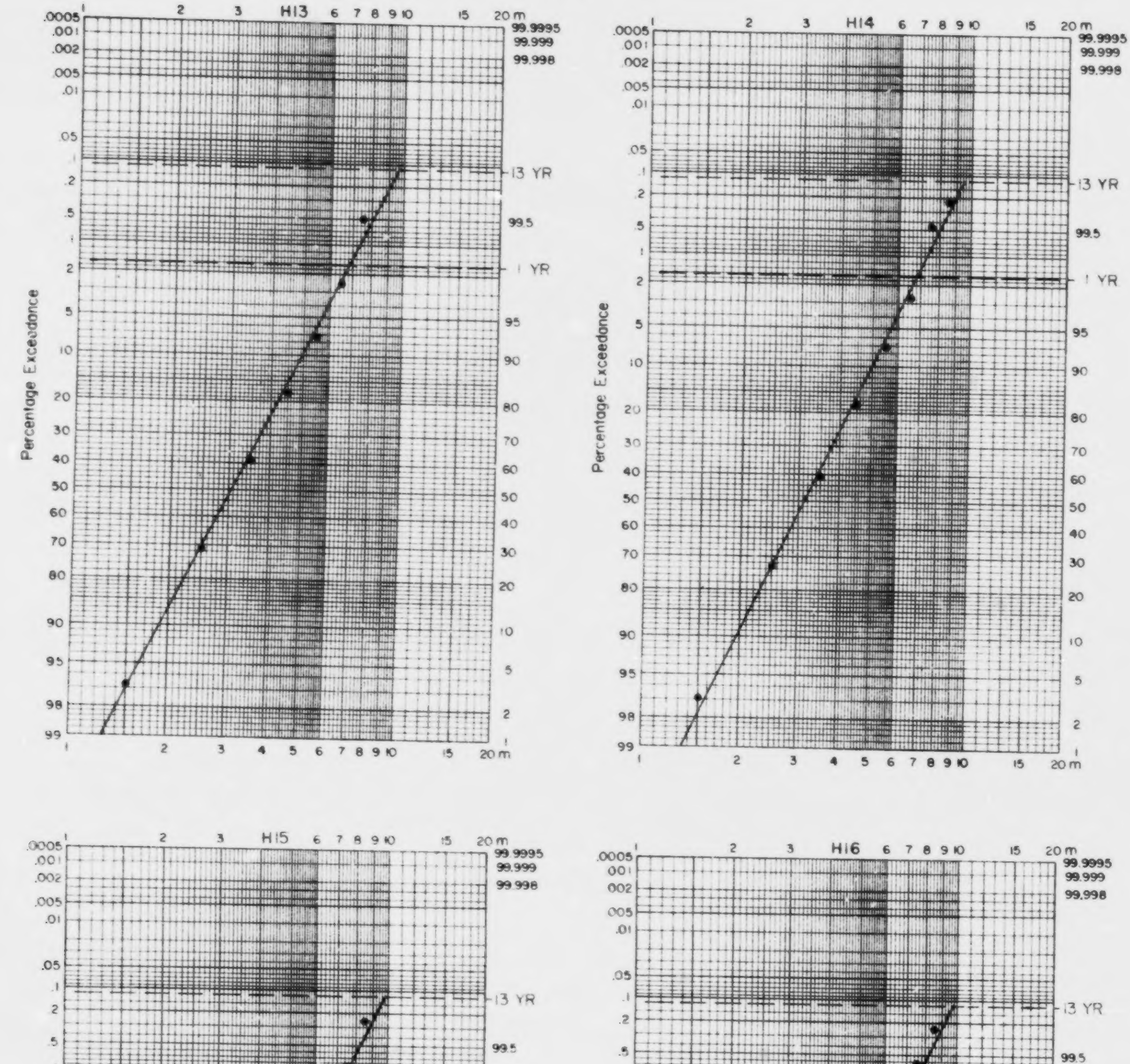


Figure Iu. Monthly Wave Height Exceedance Distribution for January



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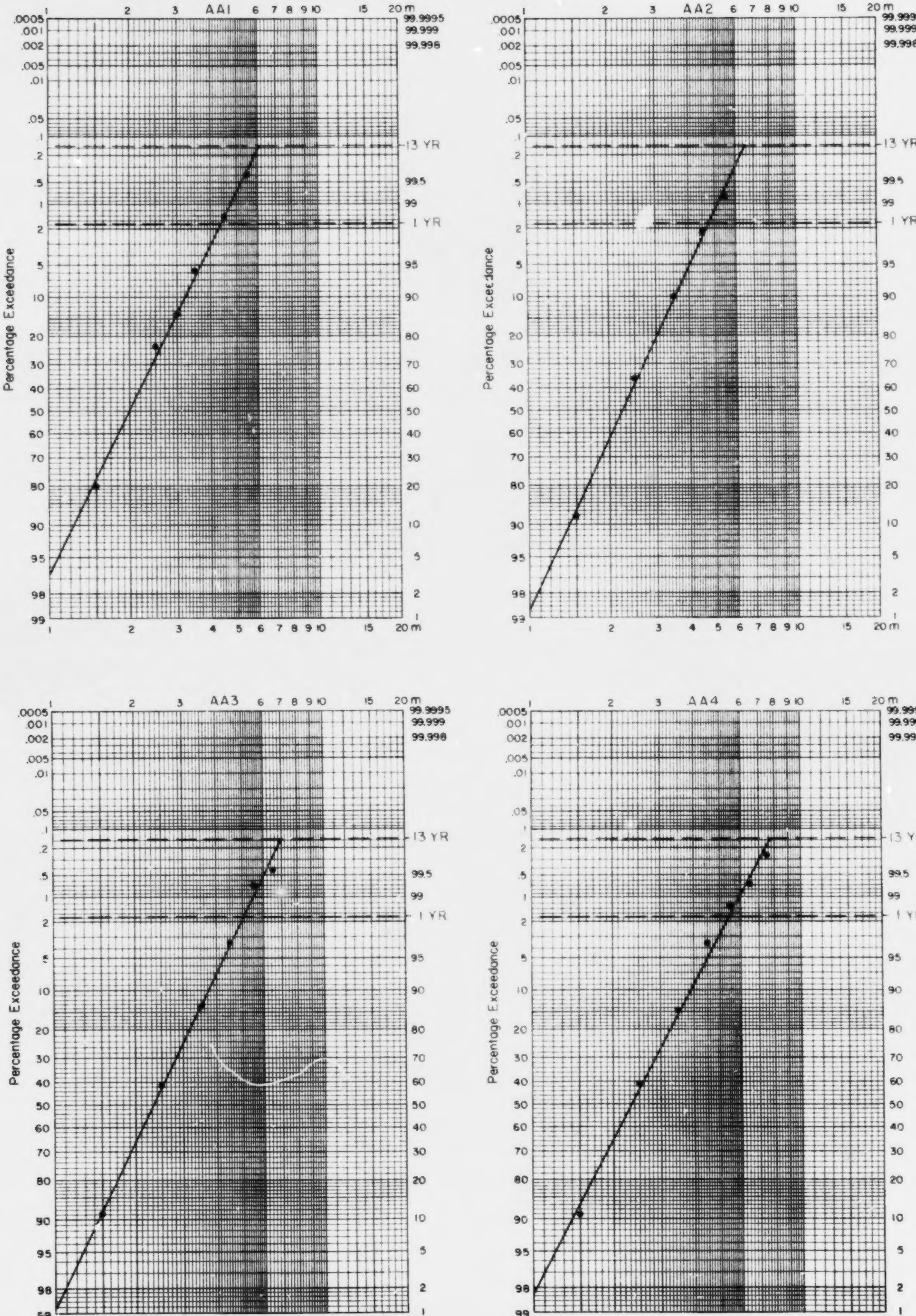

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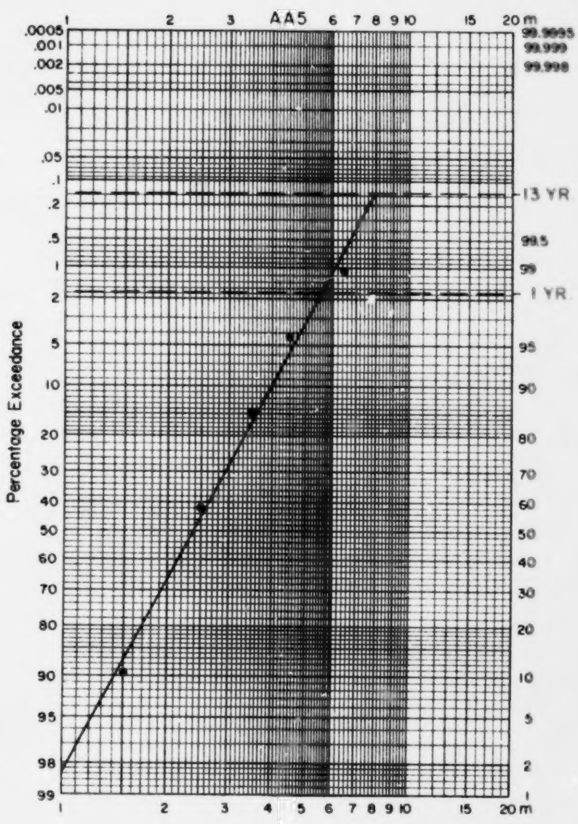

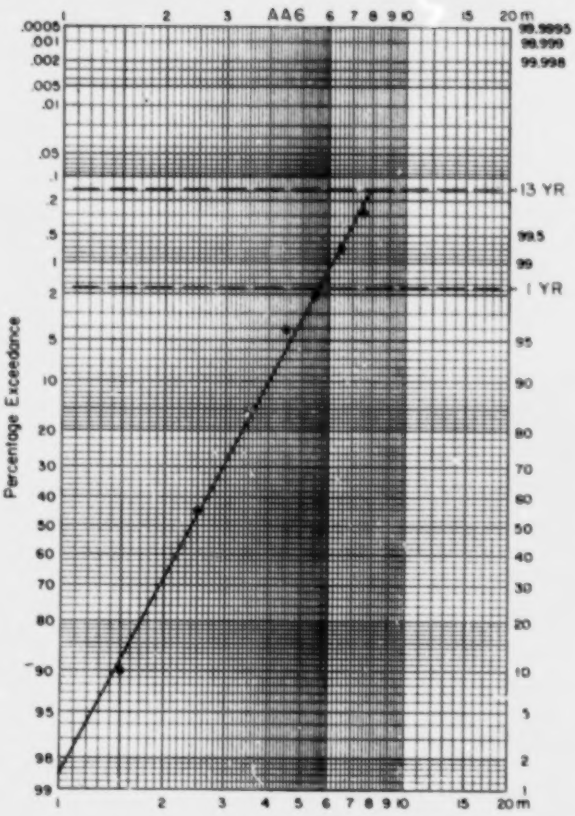

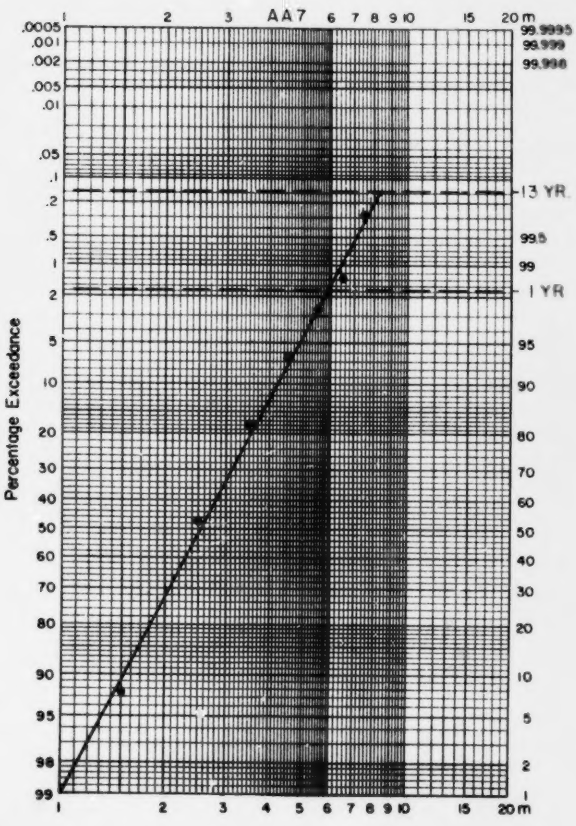

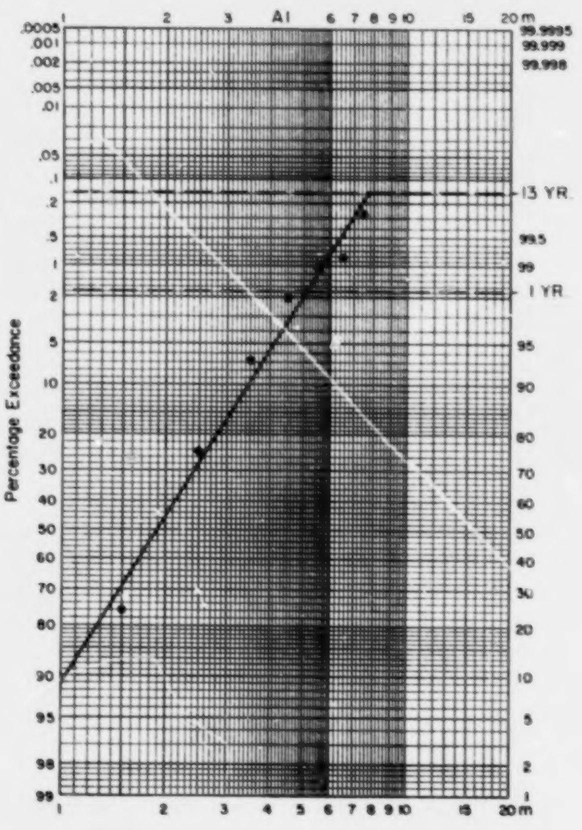

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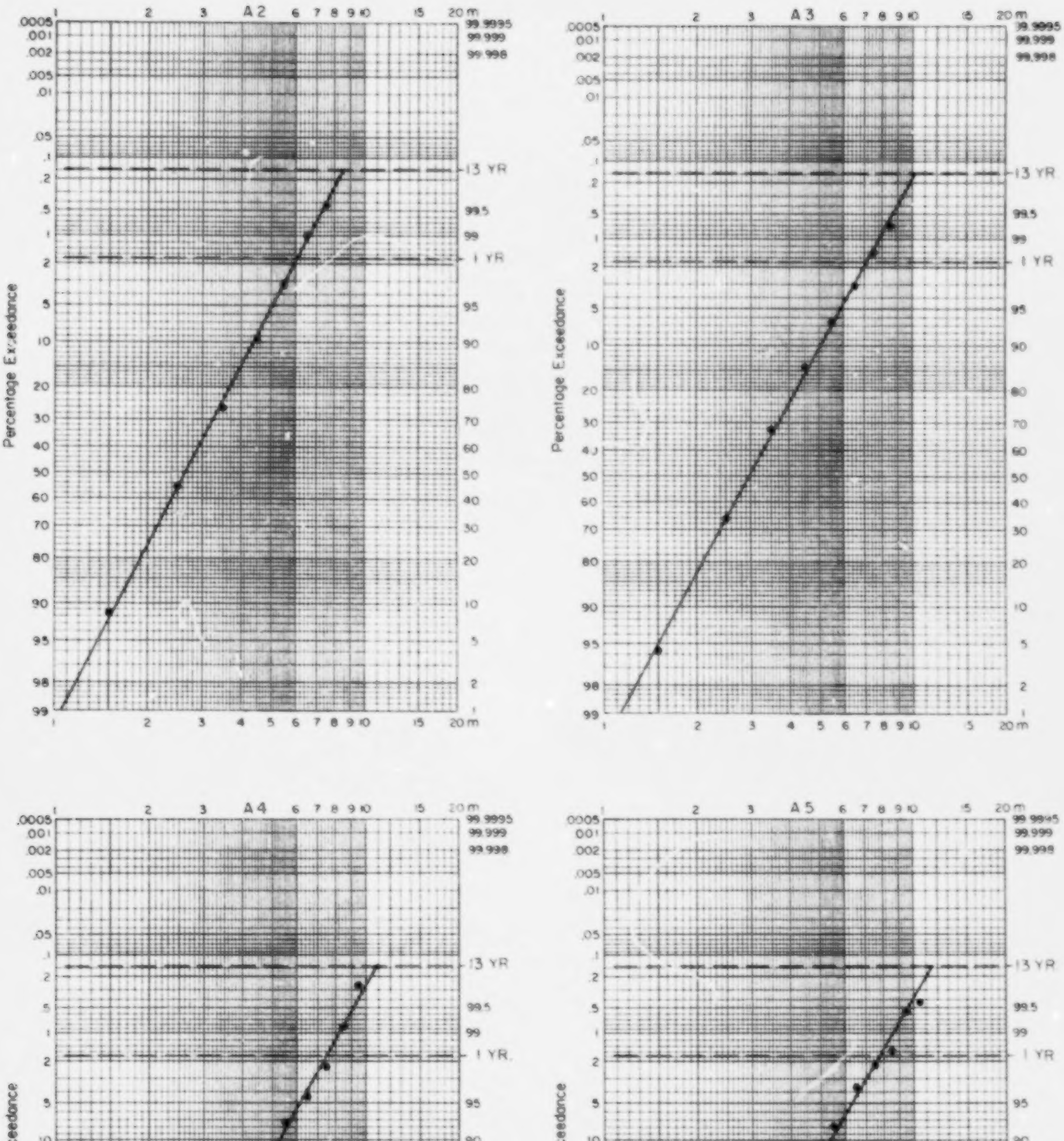

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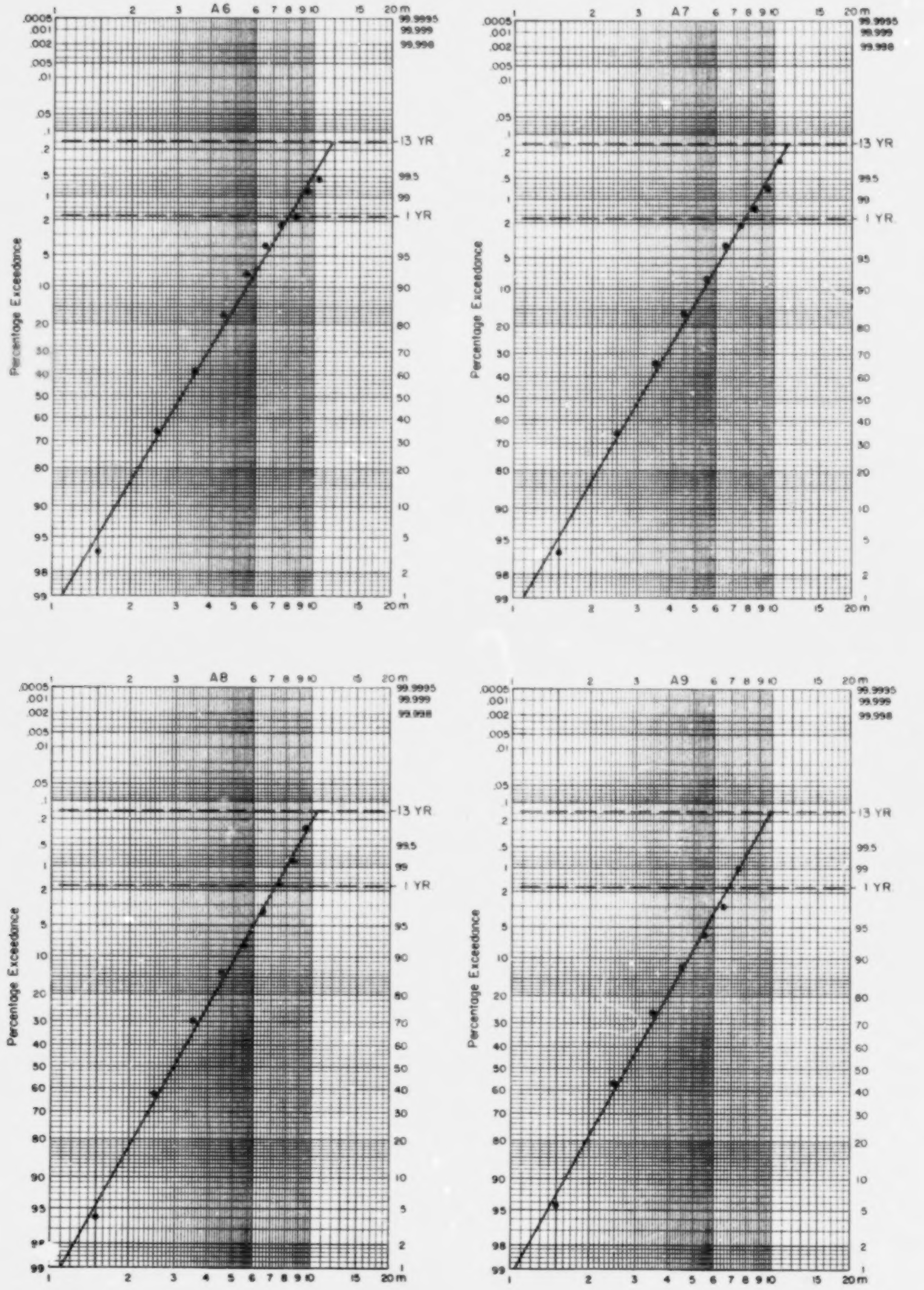

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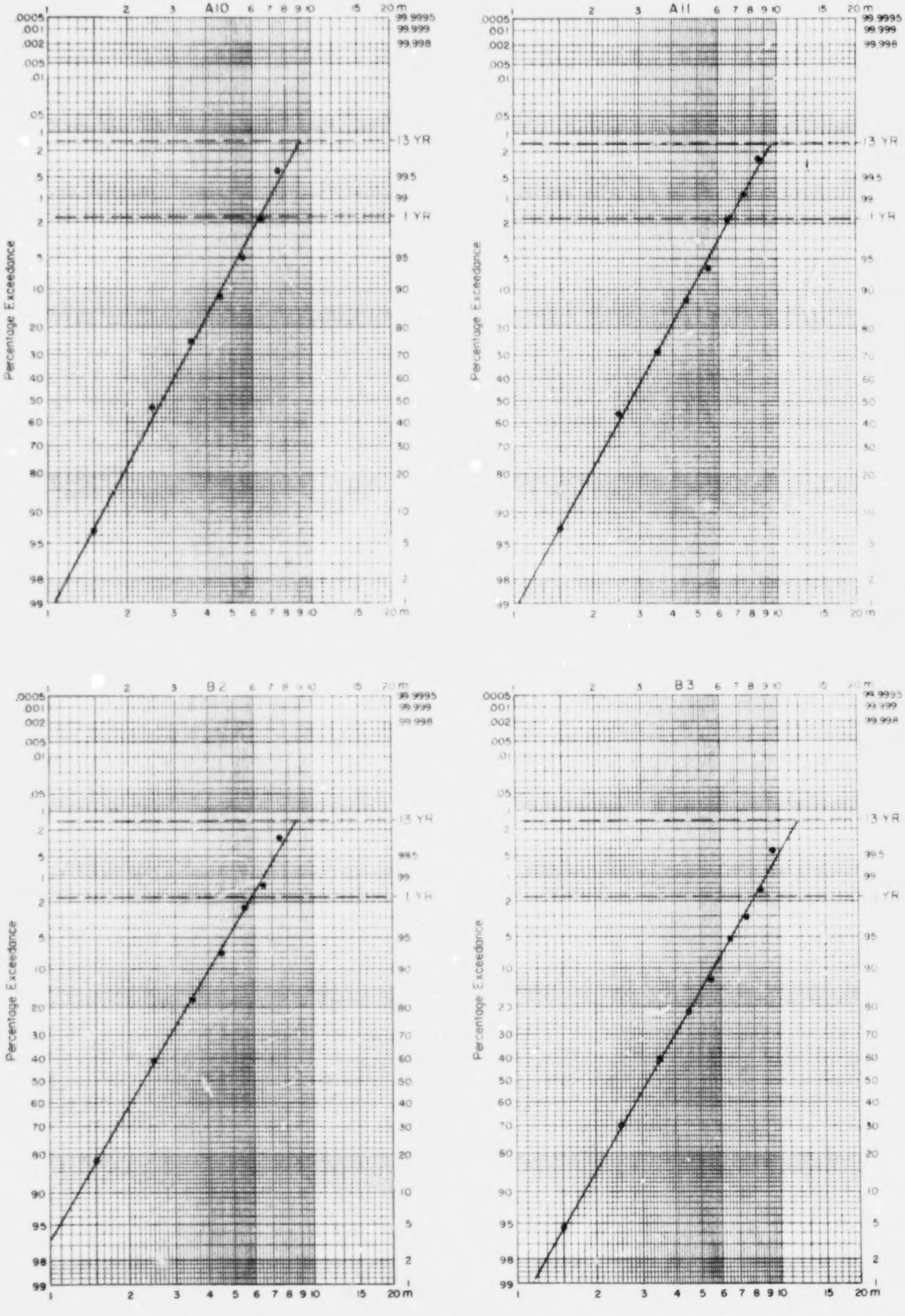

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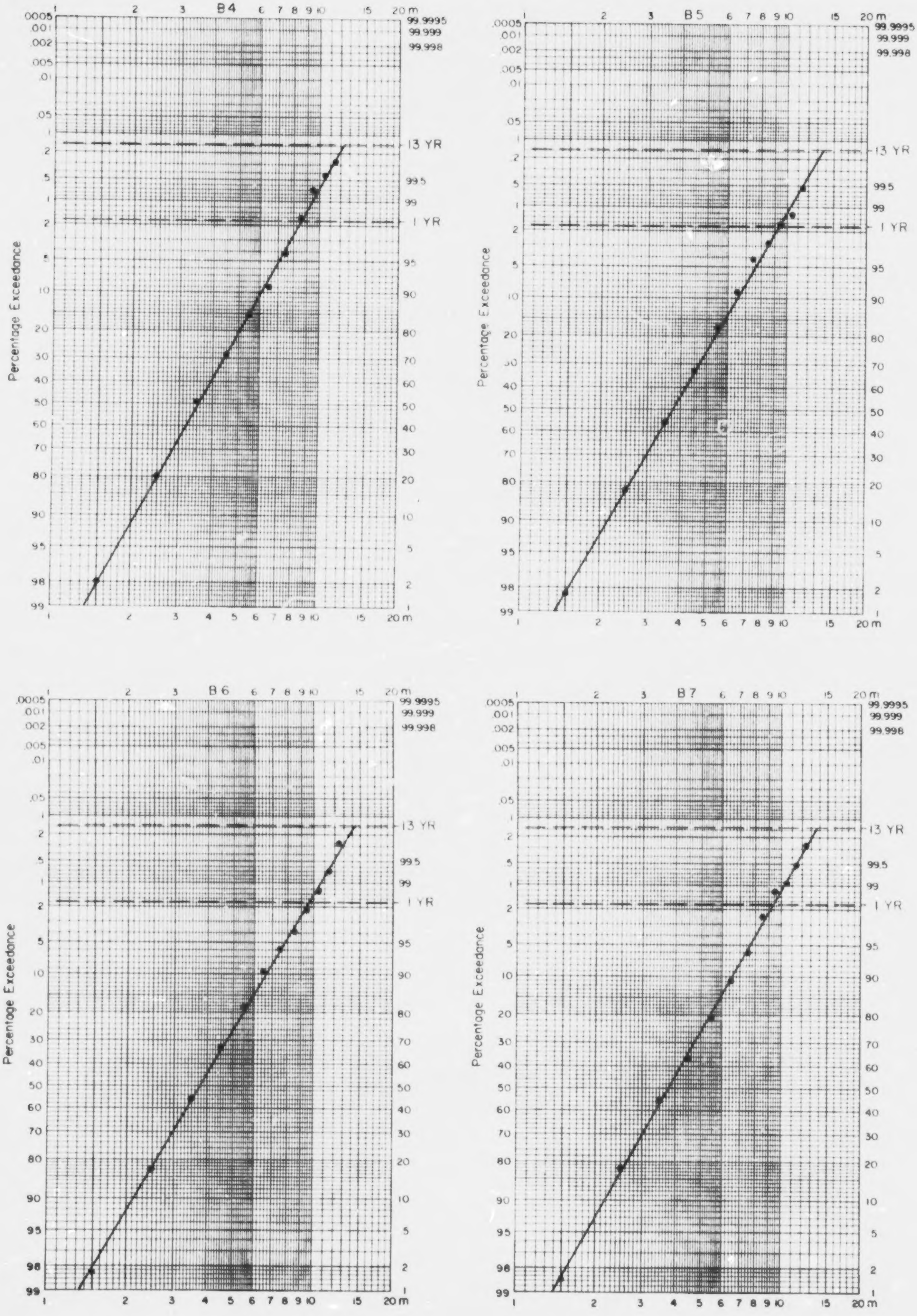

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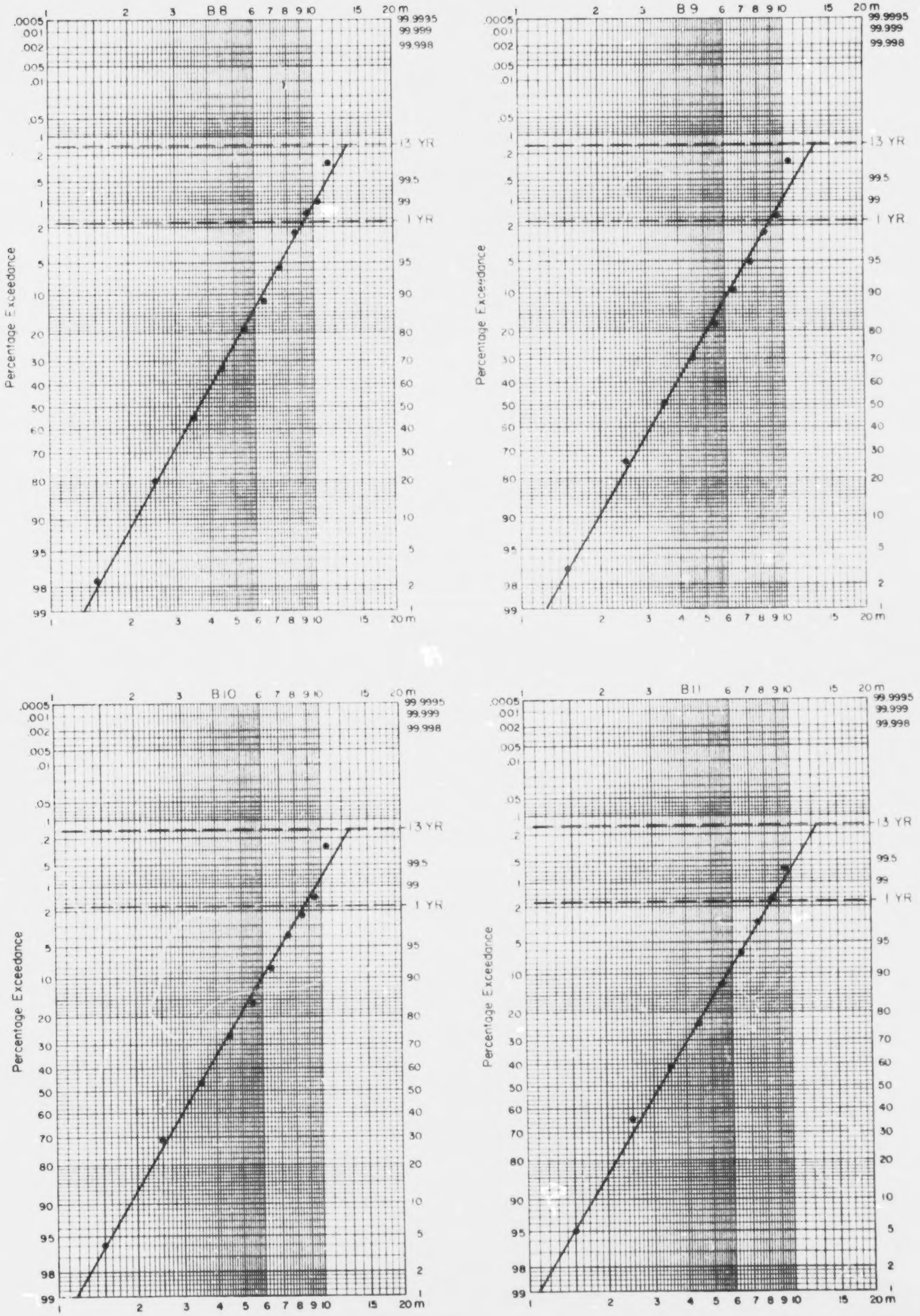

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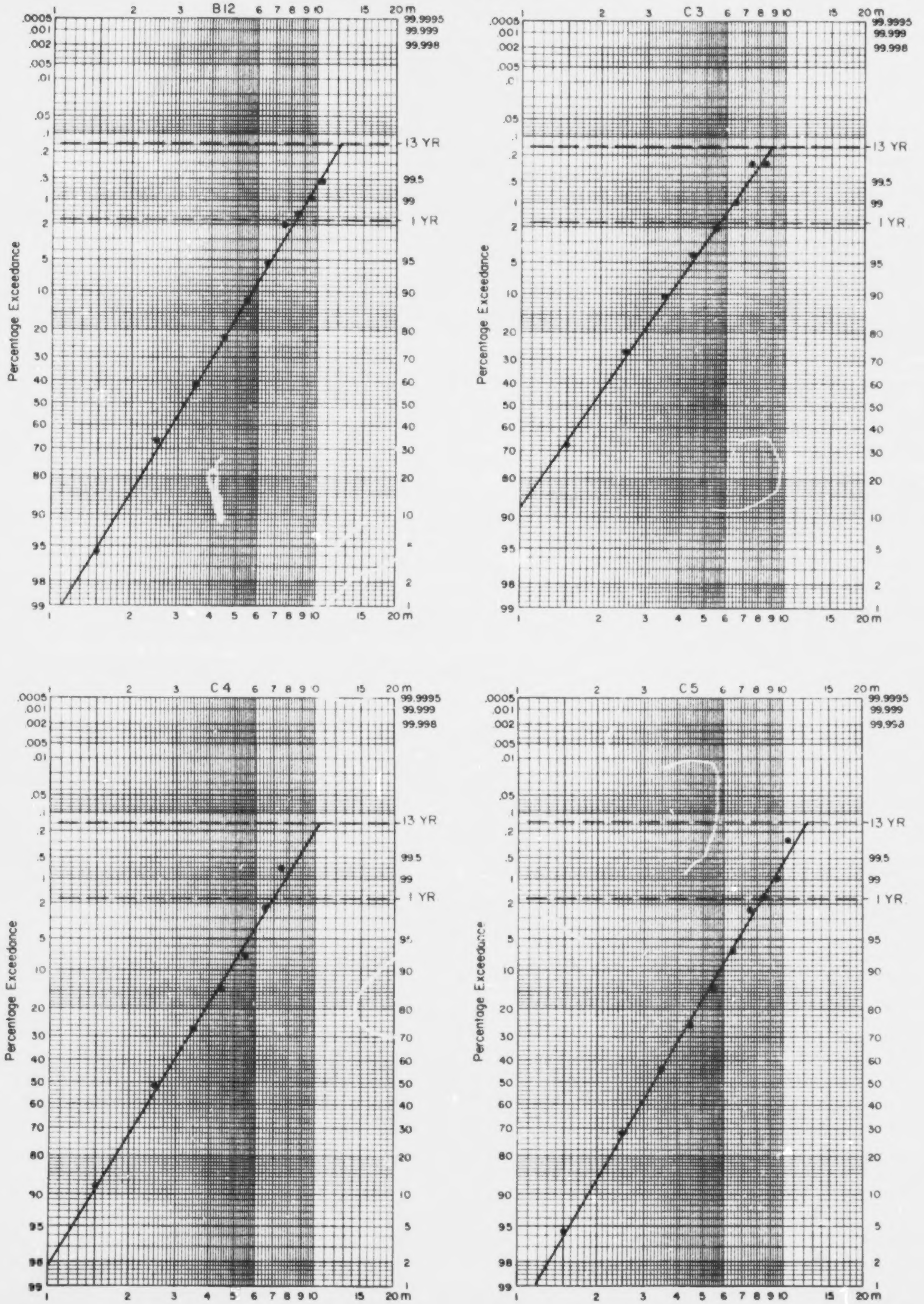

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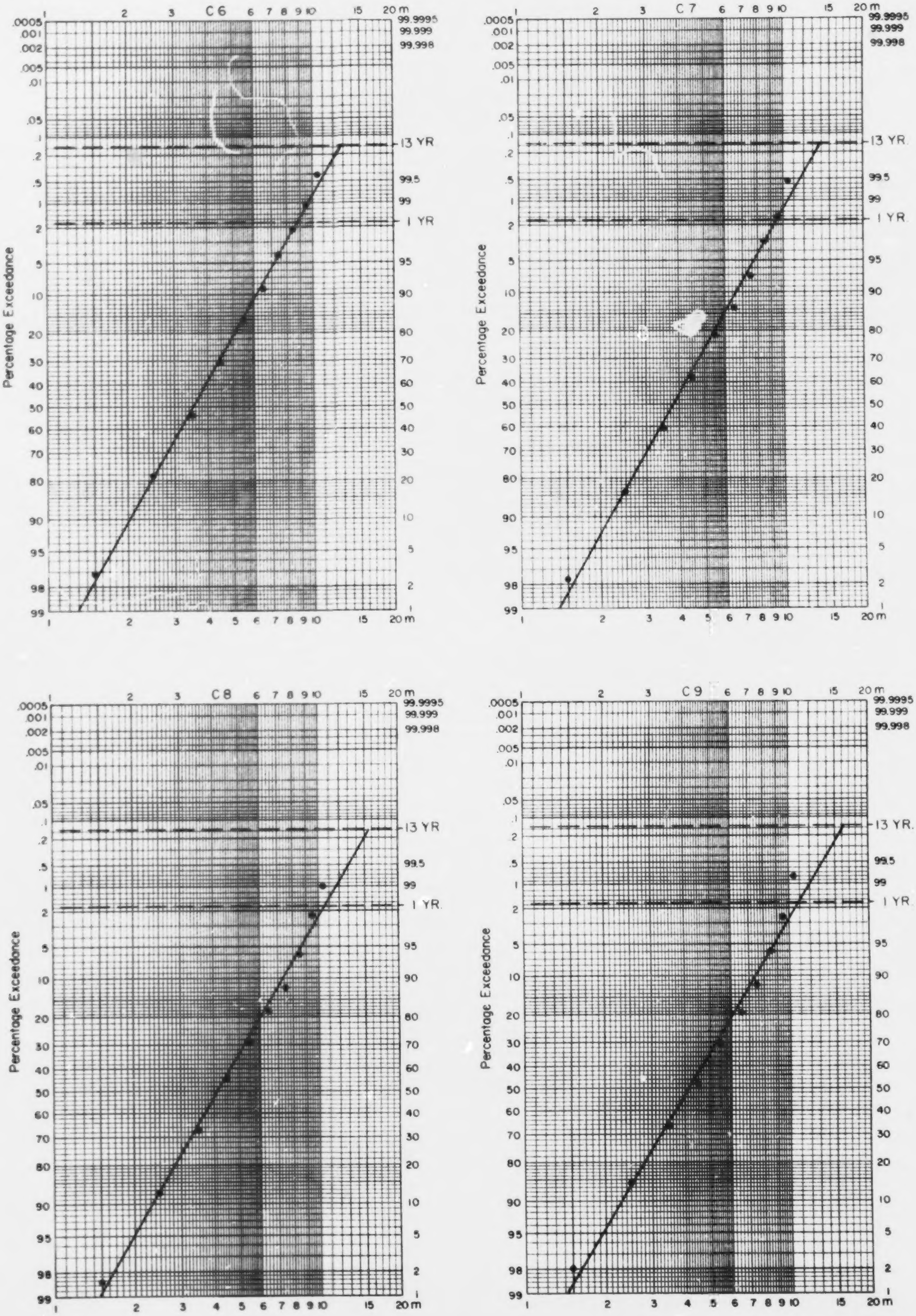

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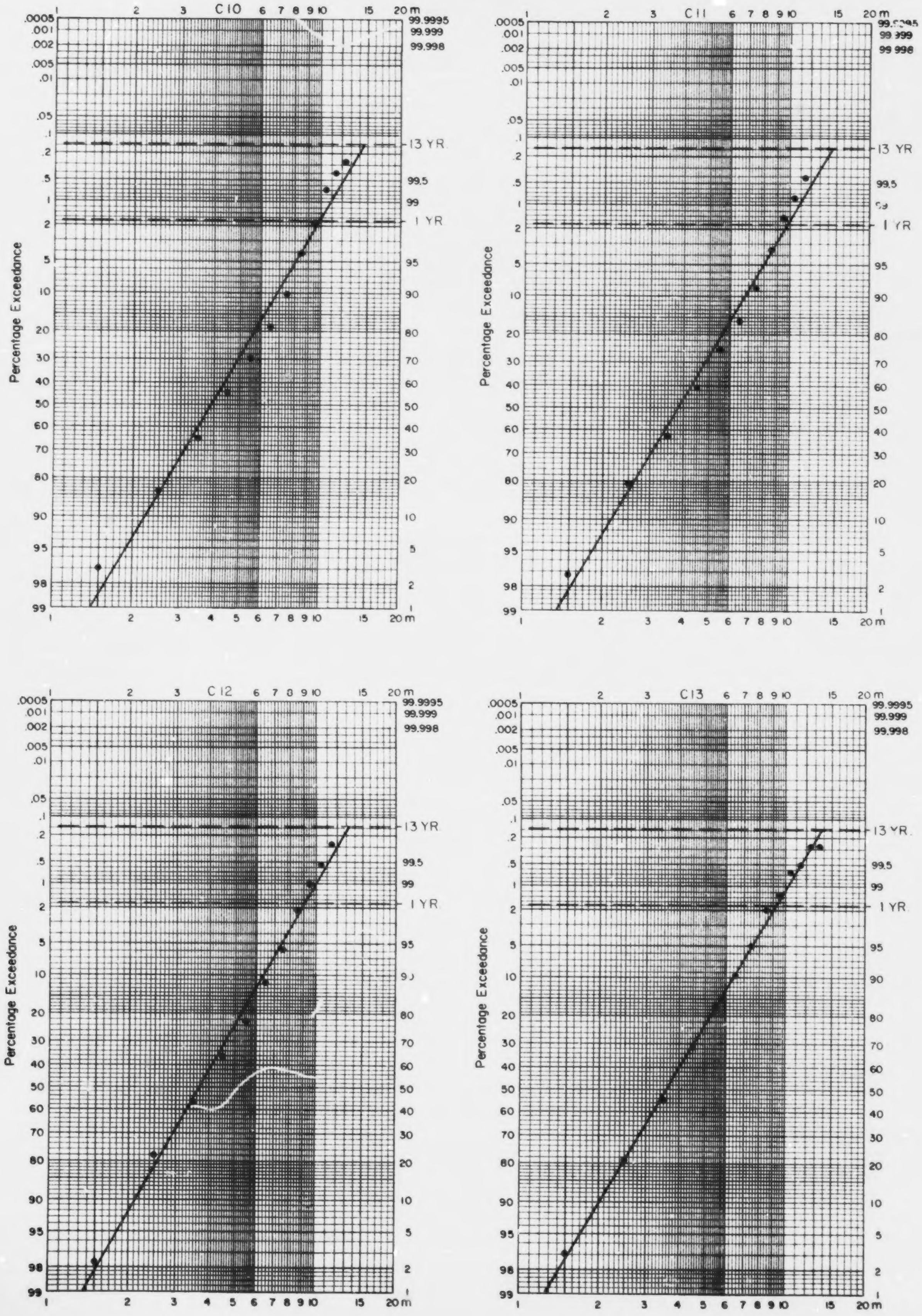

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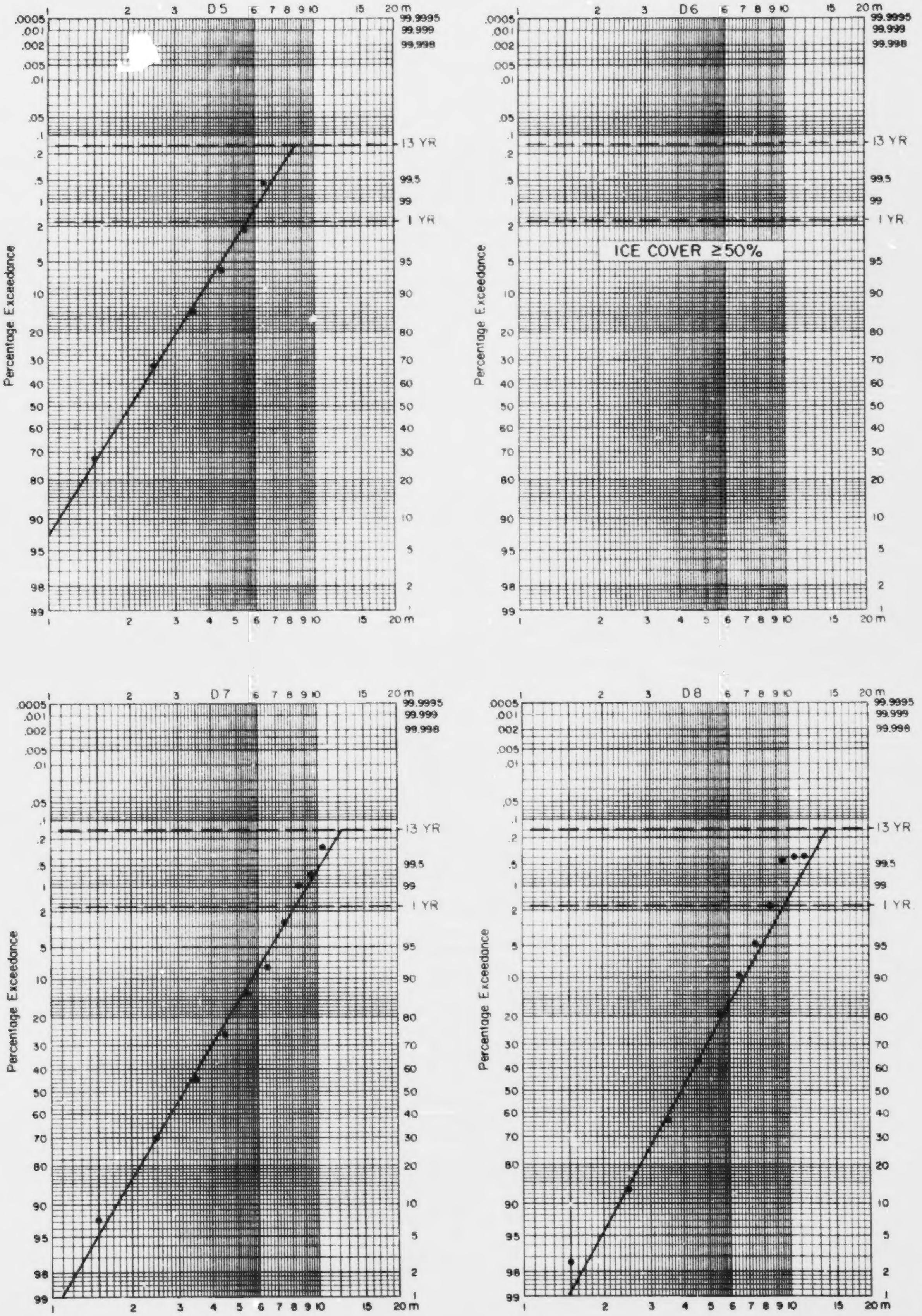

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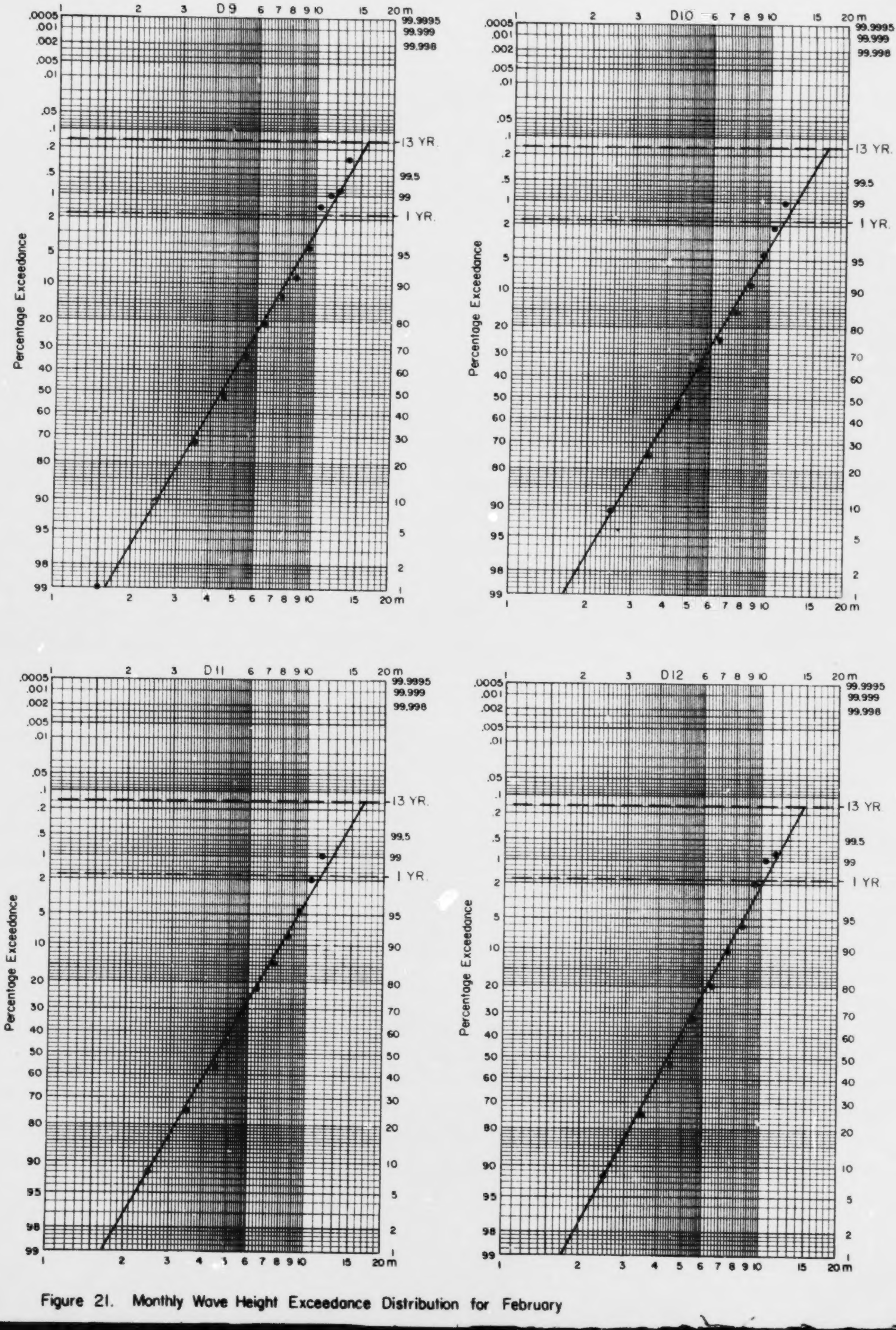

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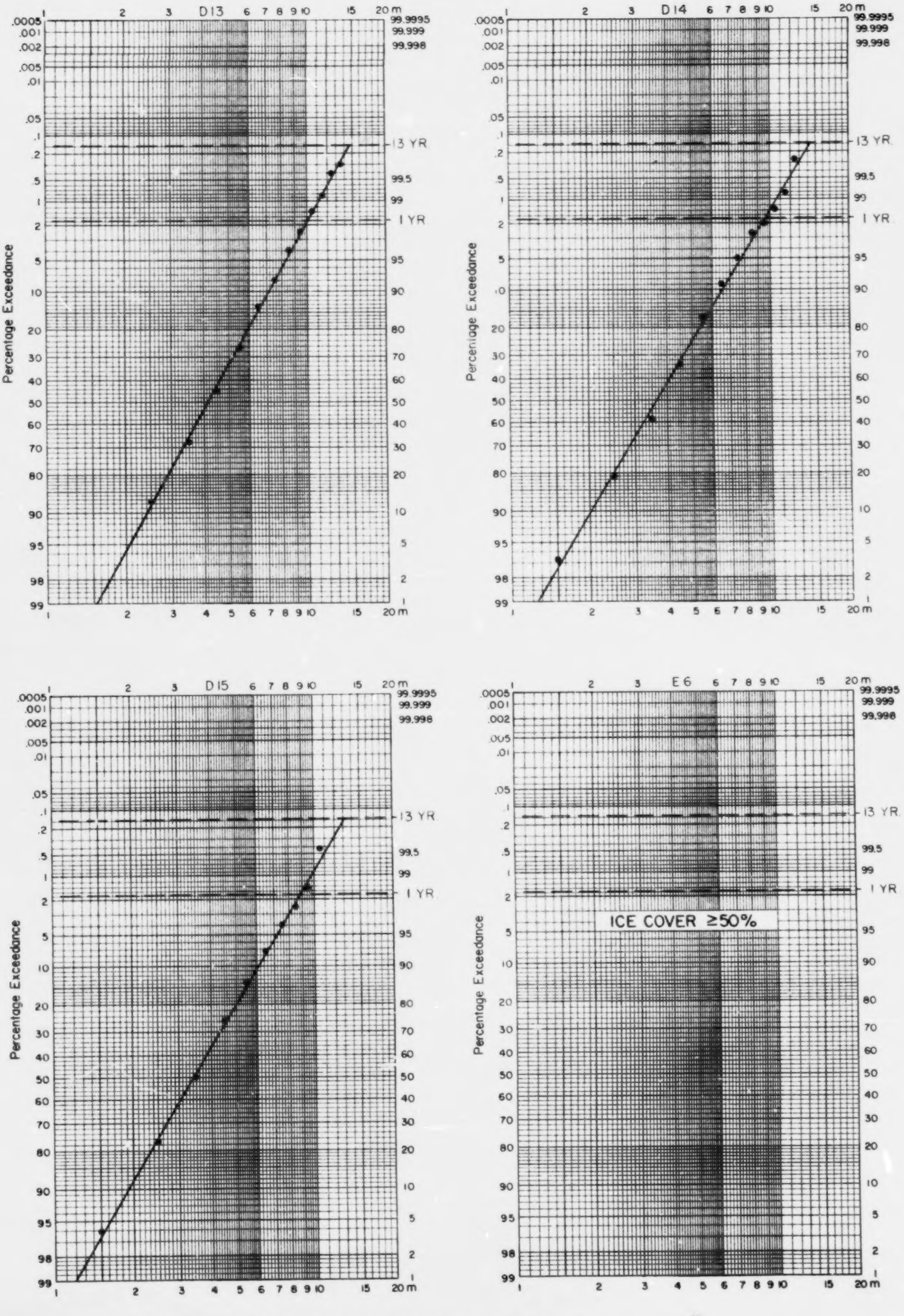

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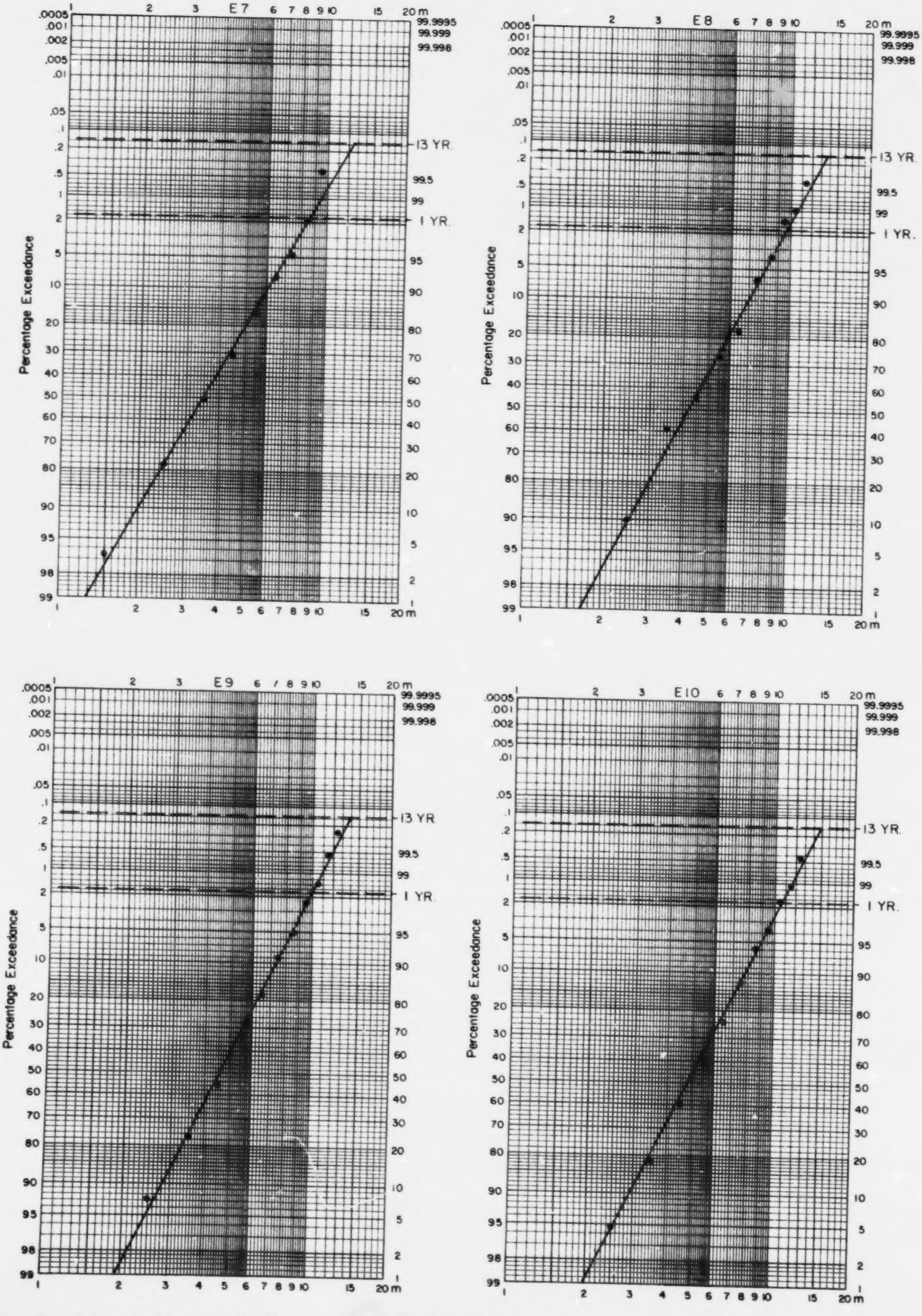

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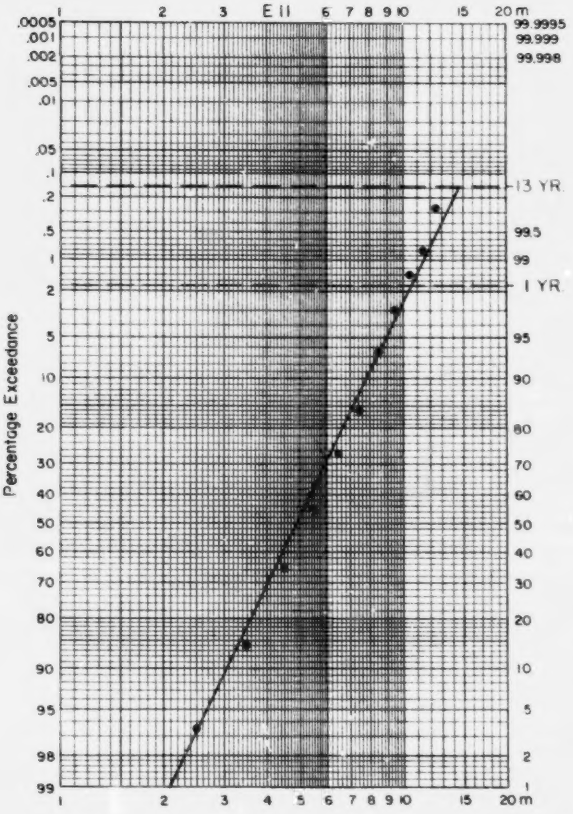

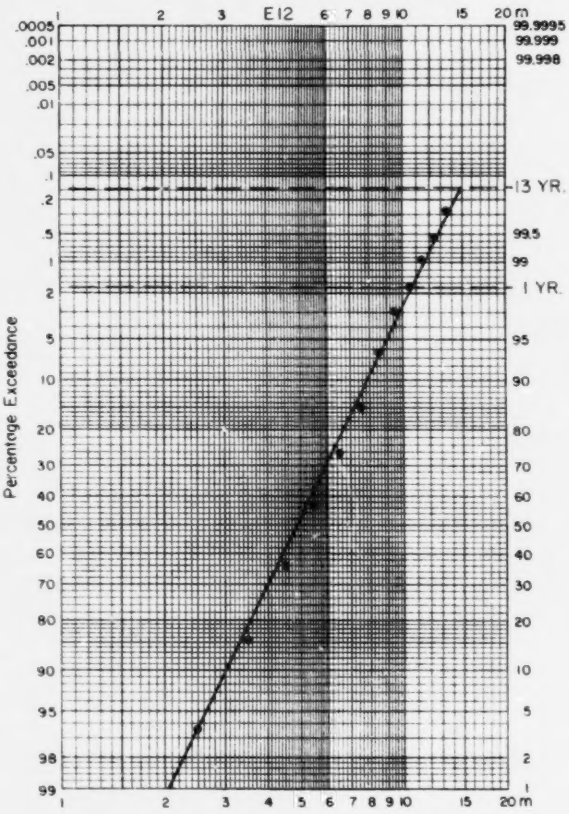

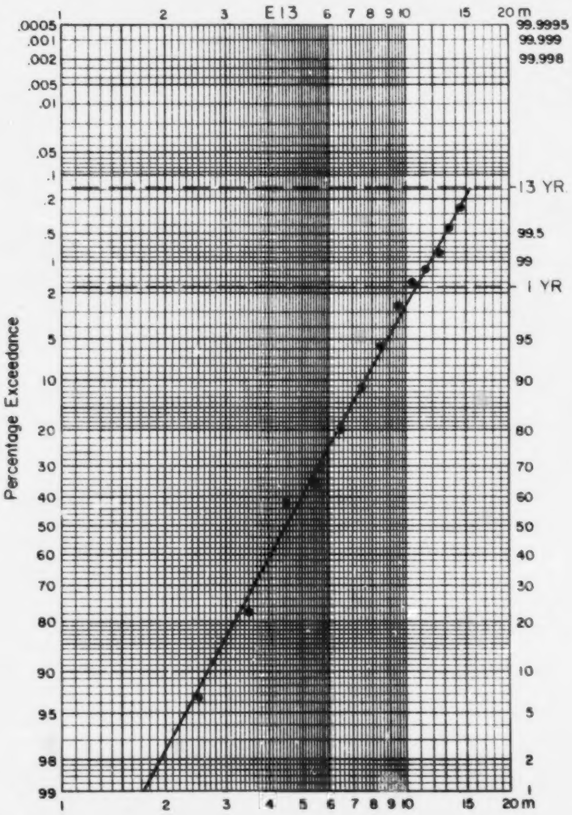

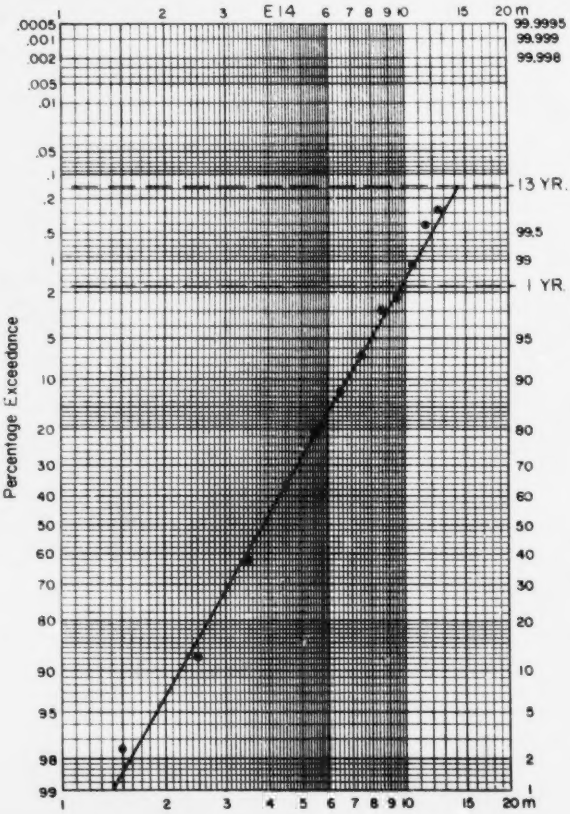

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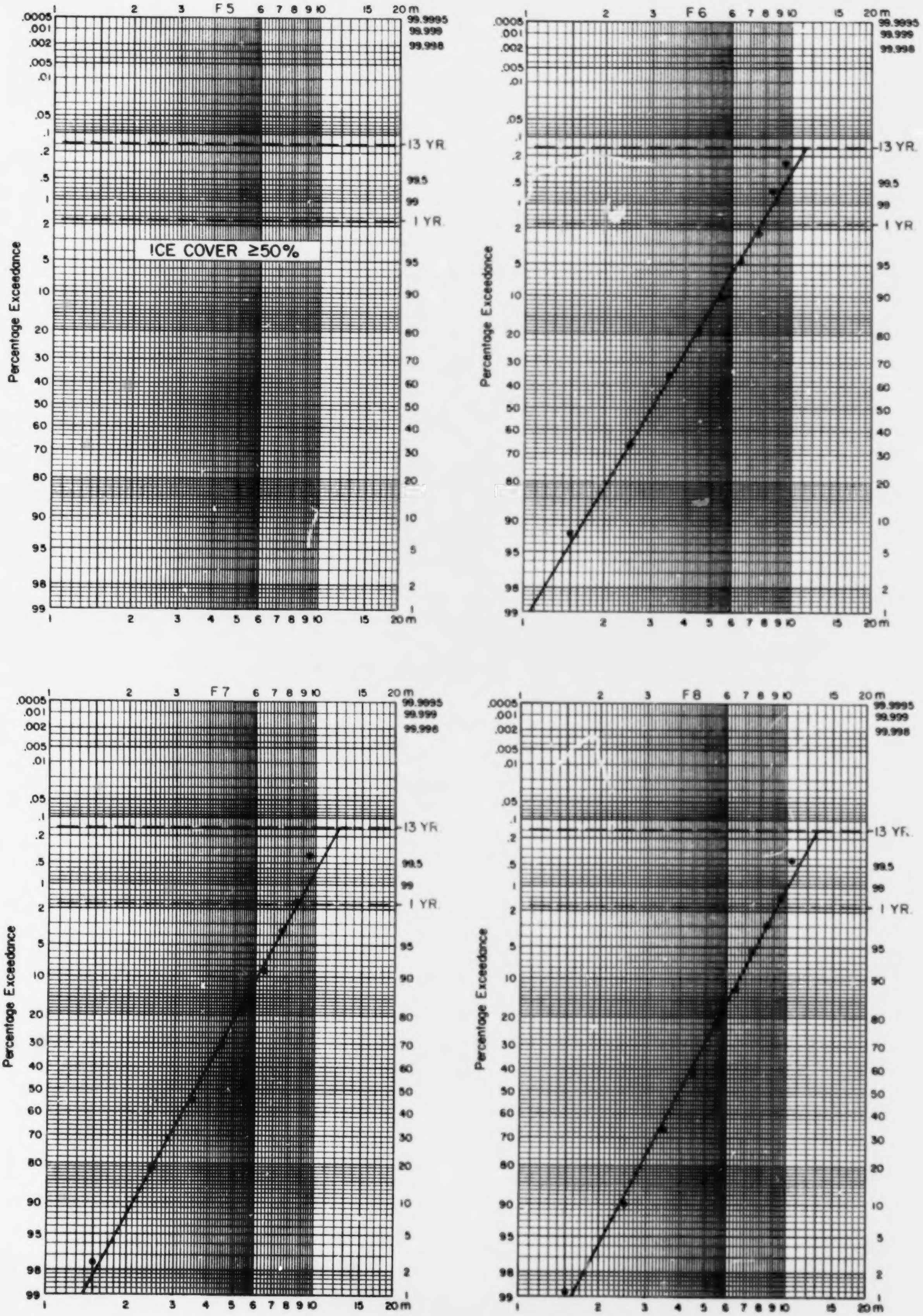

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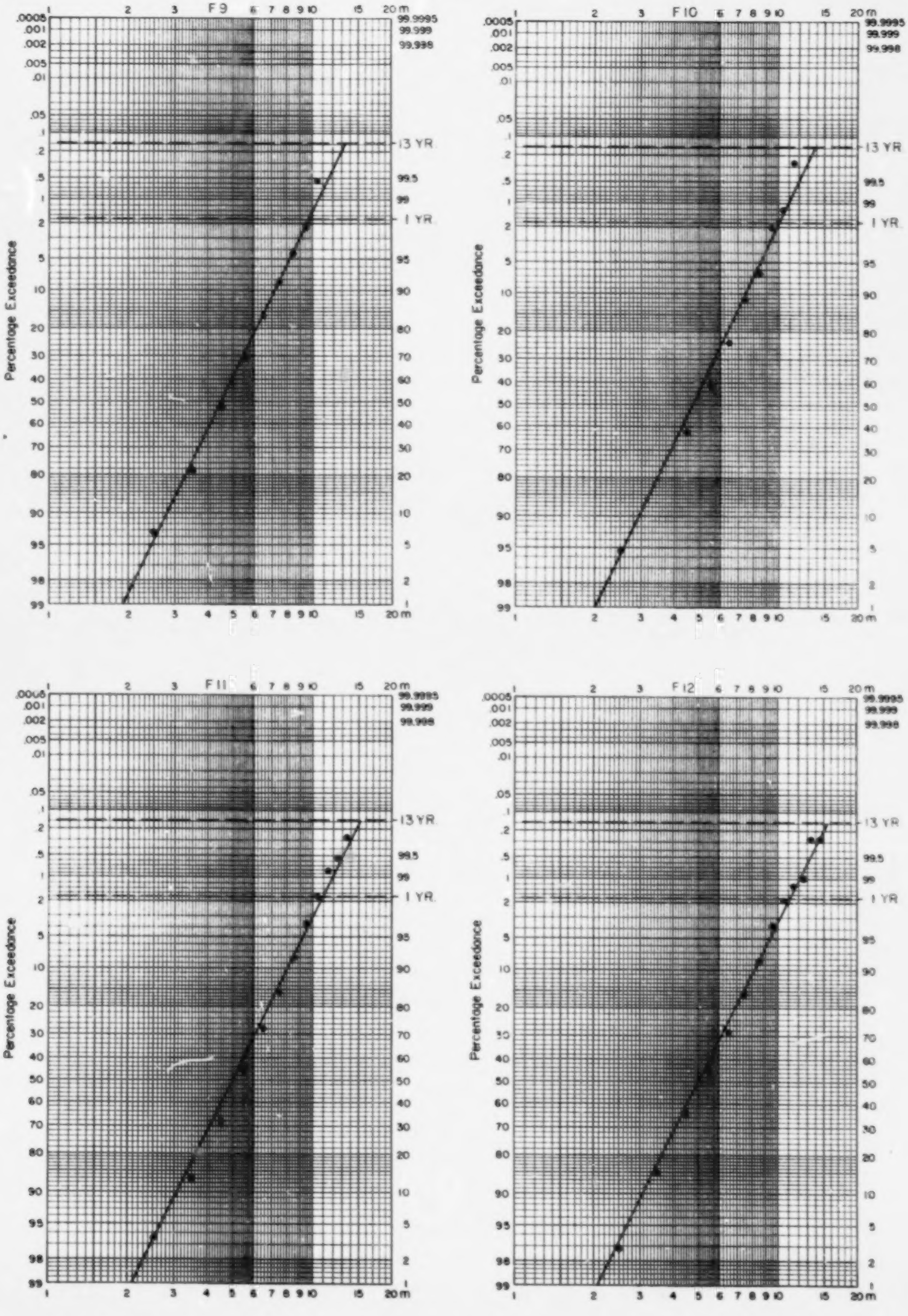

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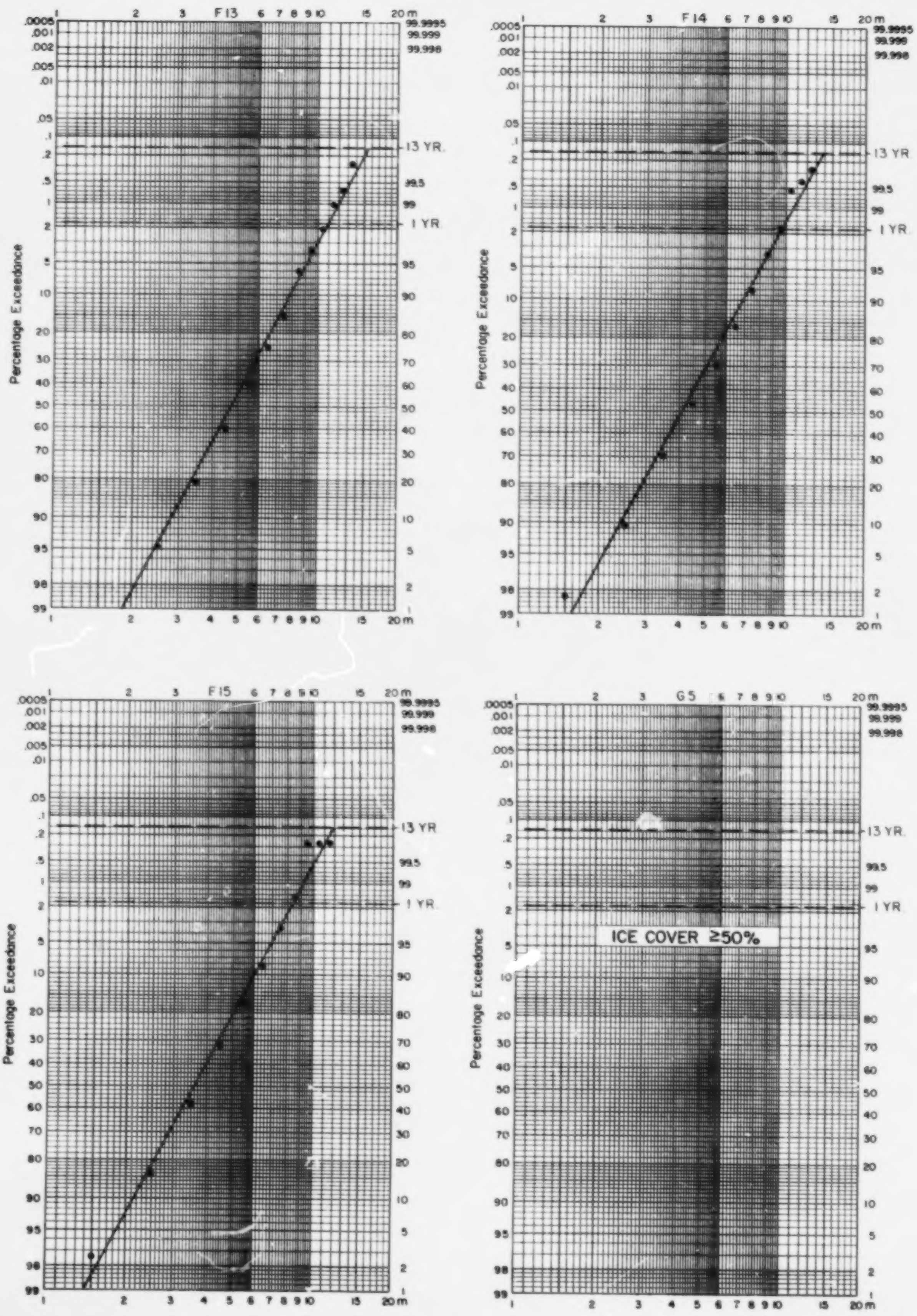

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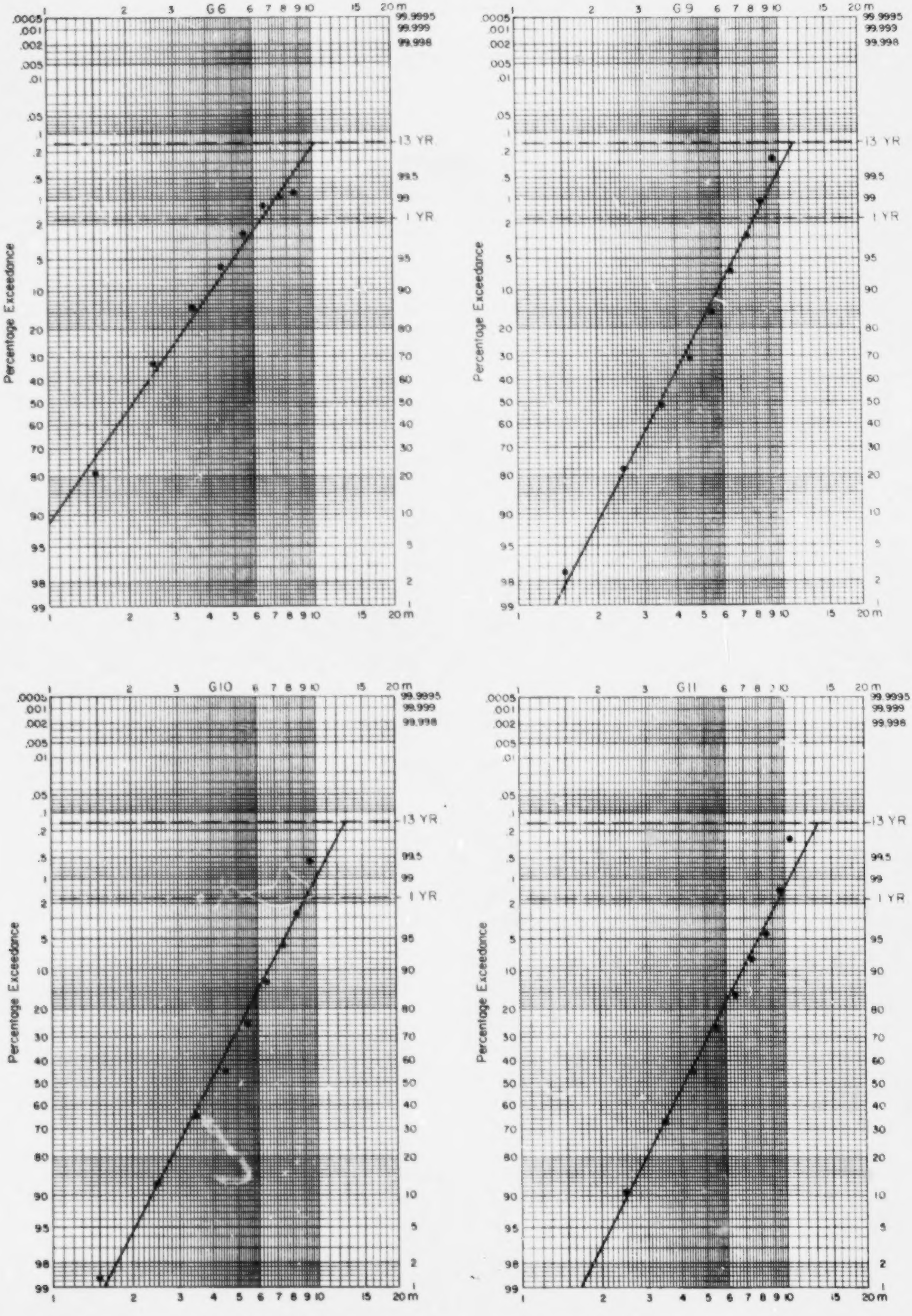

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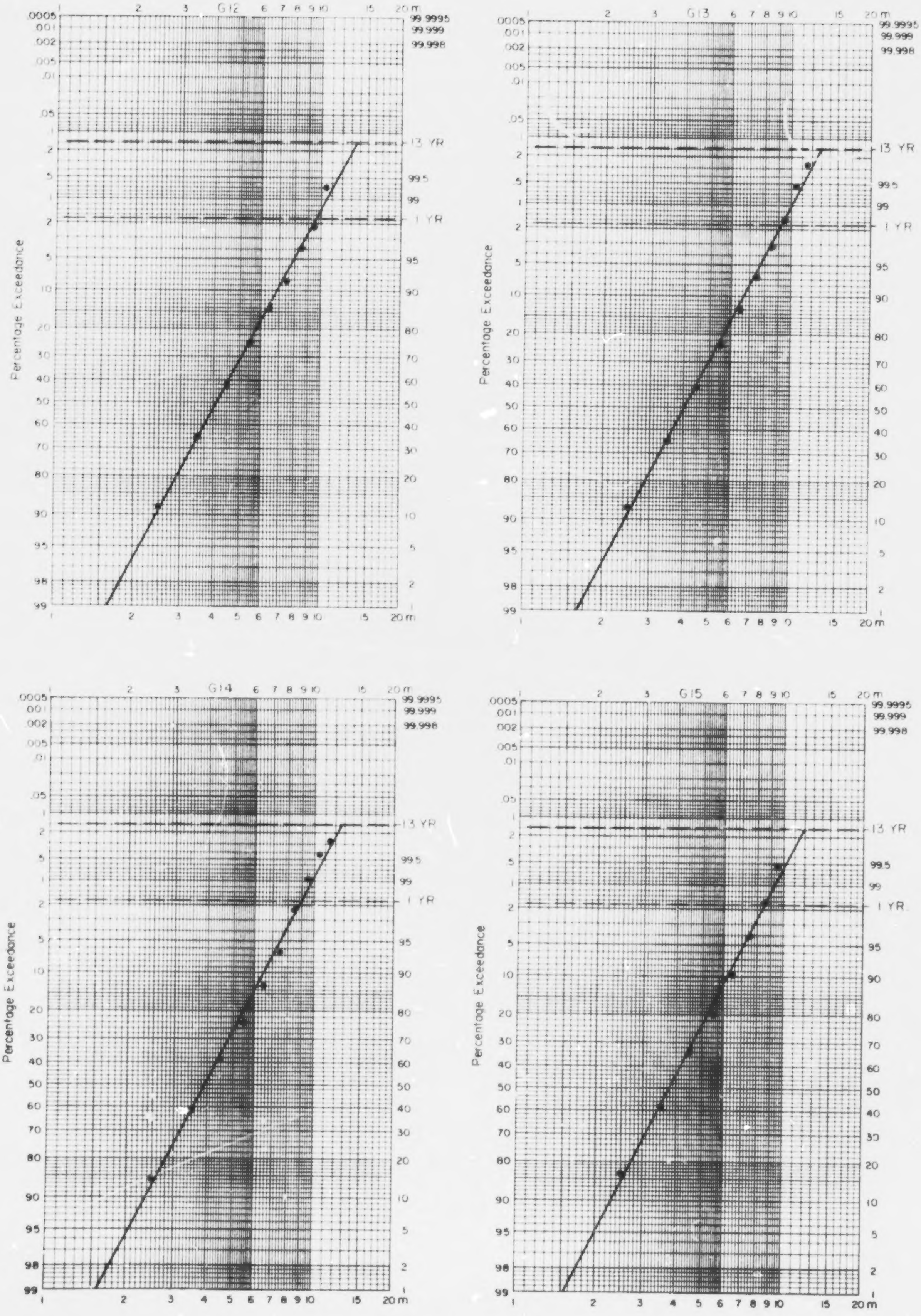

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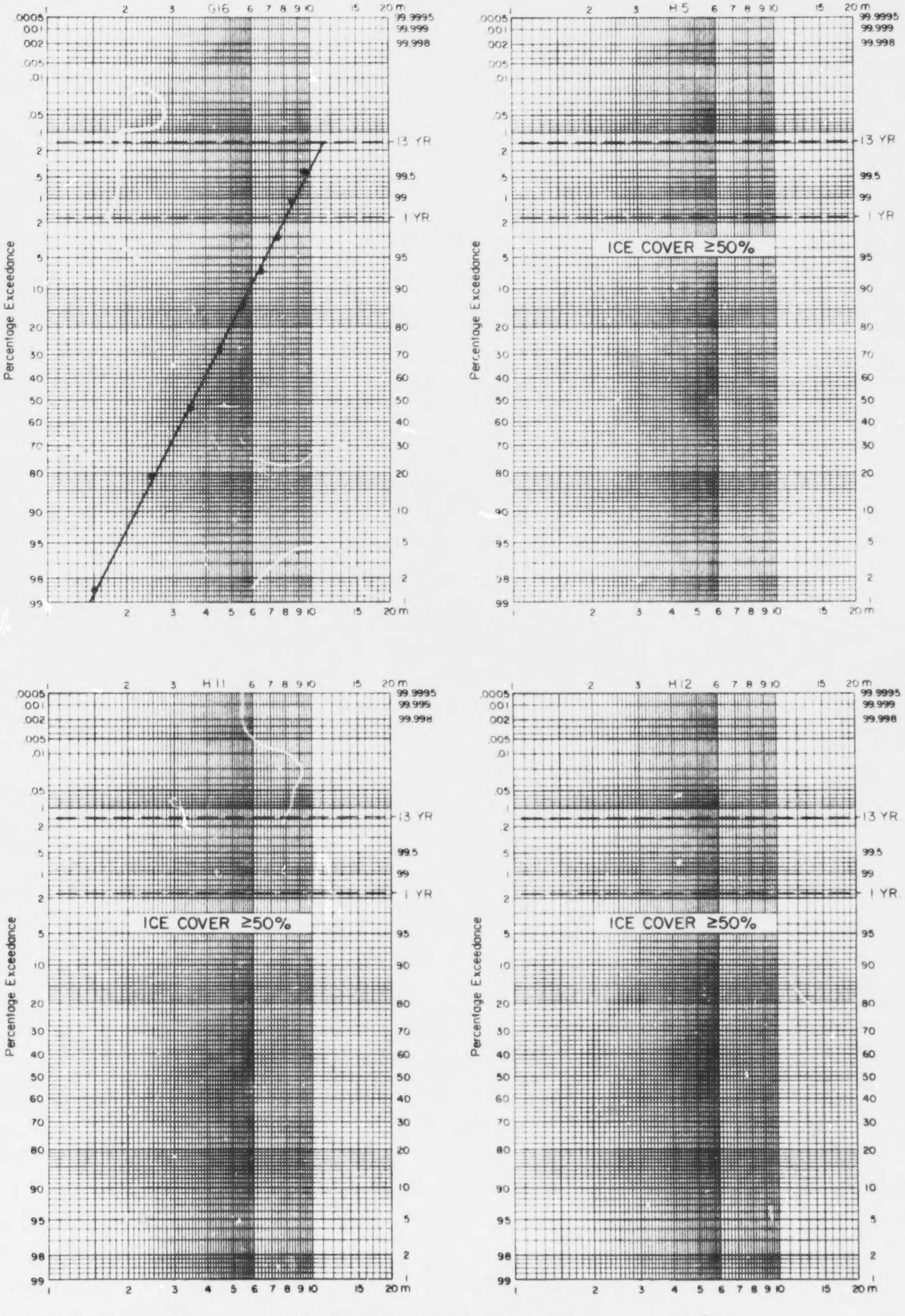


Figure 2u. Monthly Wave Height Exceedance Distribution for February

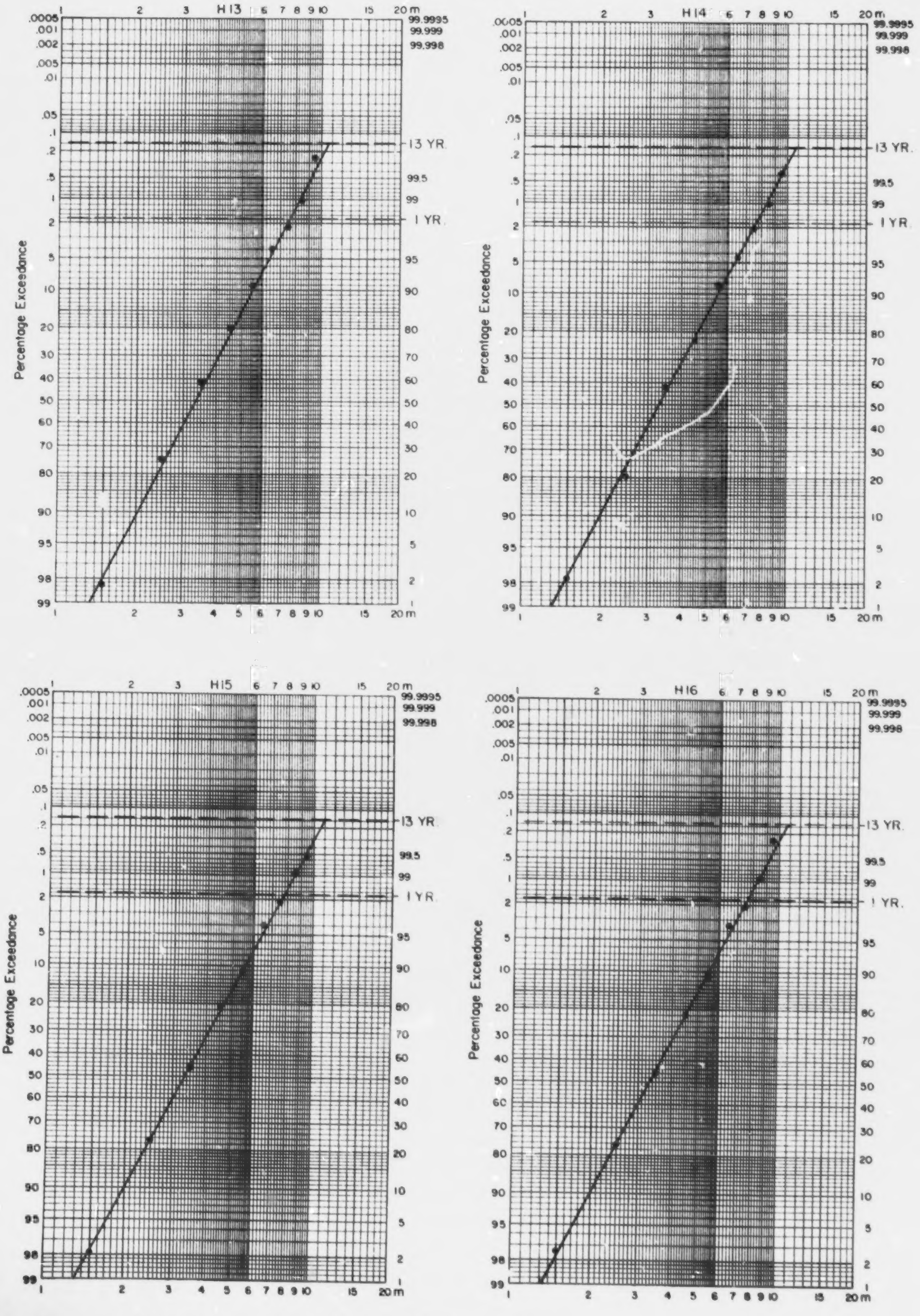


Figure 2v. Monthly Wave Height Exceedance Distribution for February

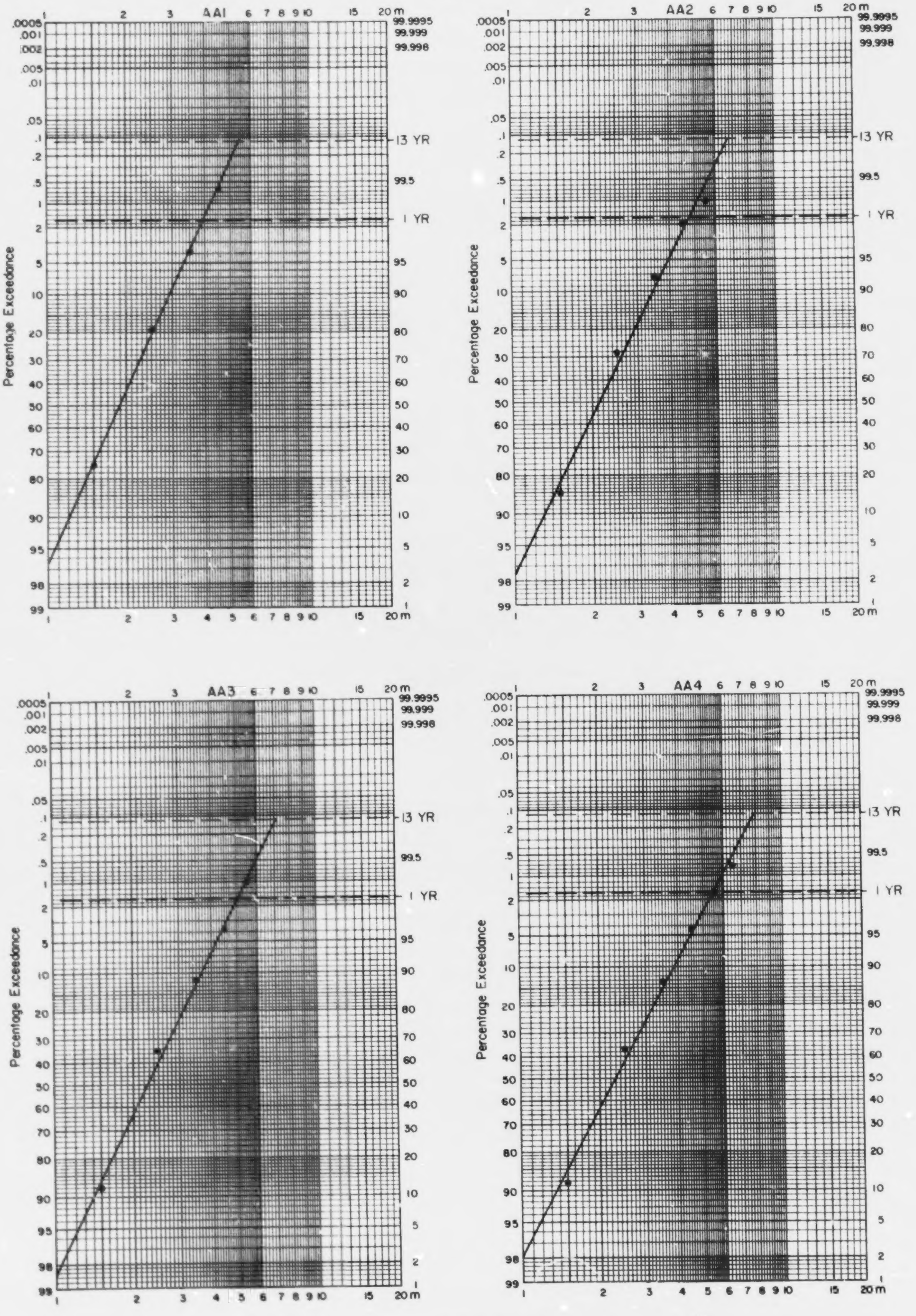


Figure [illegible]. — Monthly Wave Height Exceedance Distribution for March

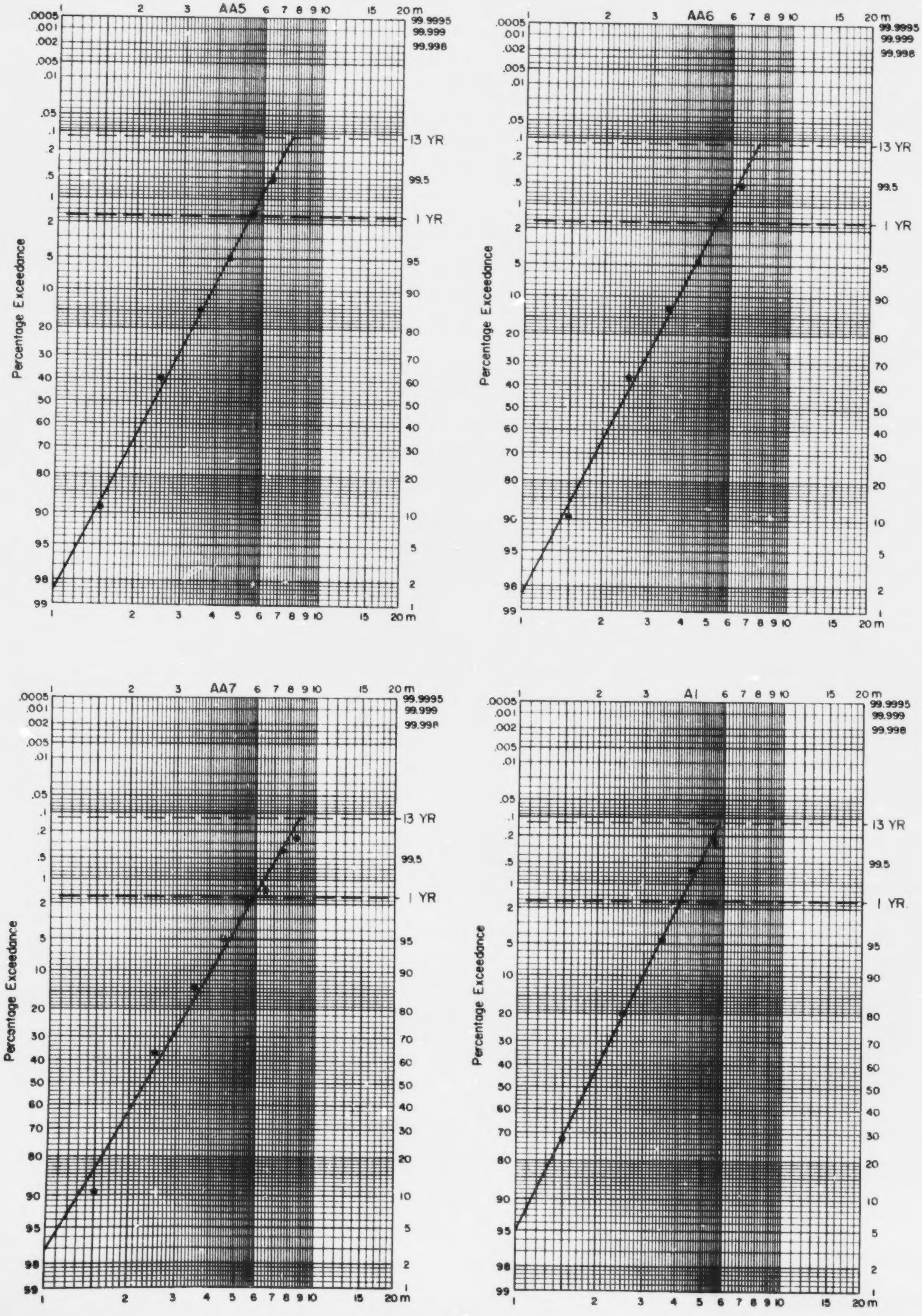


Figure 3b. Monthly Wave Height Exceedance Distribution for March

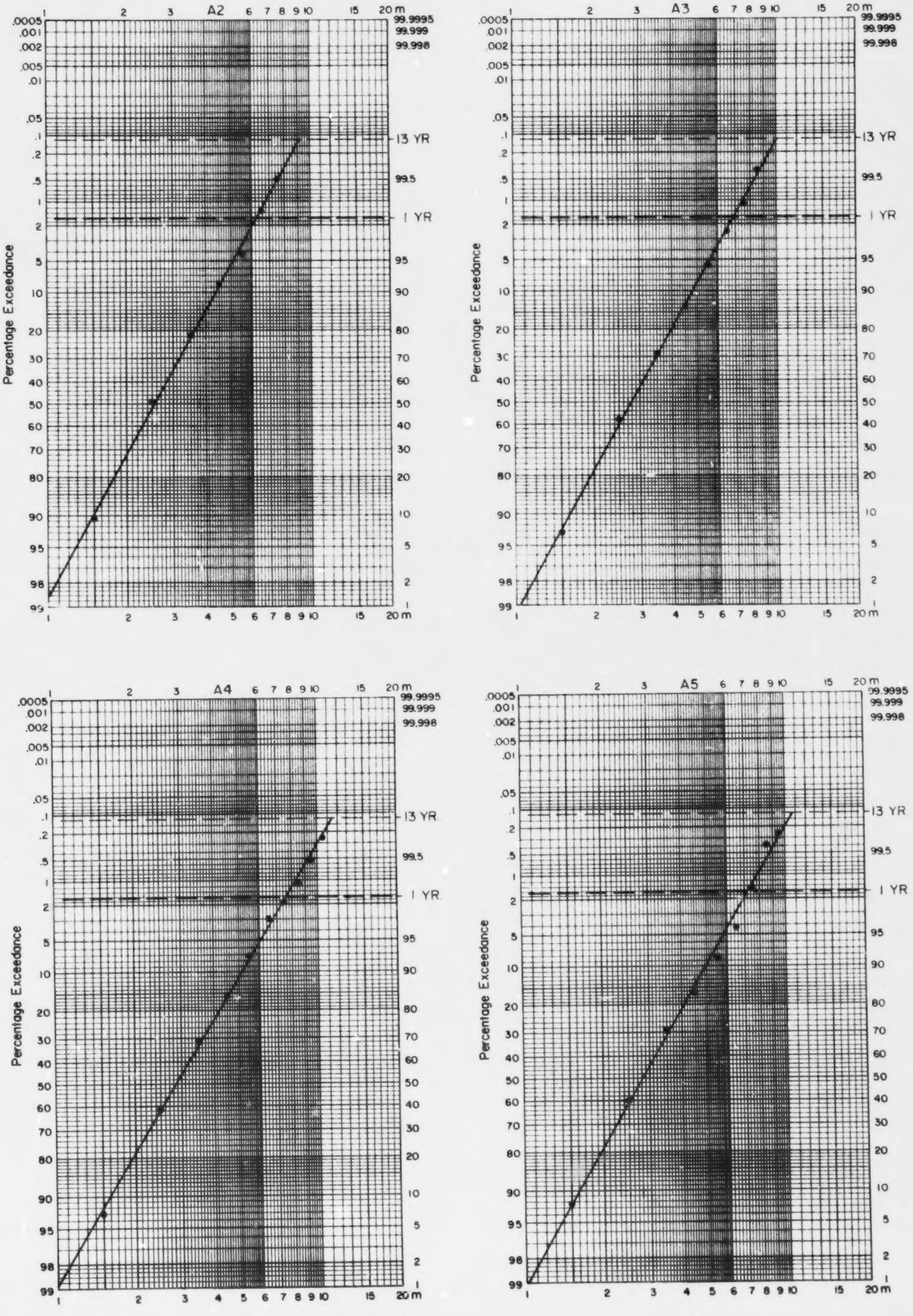


Figure 3c. Monthly Wave Height Exceedance Distribution for March

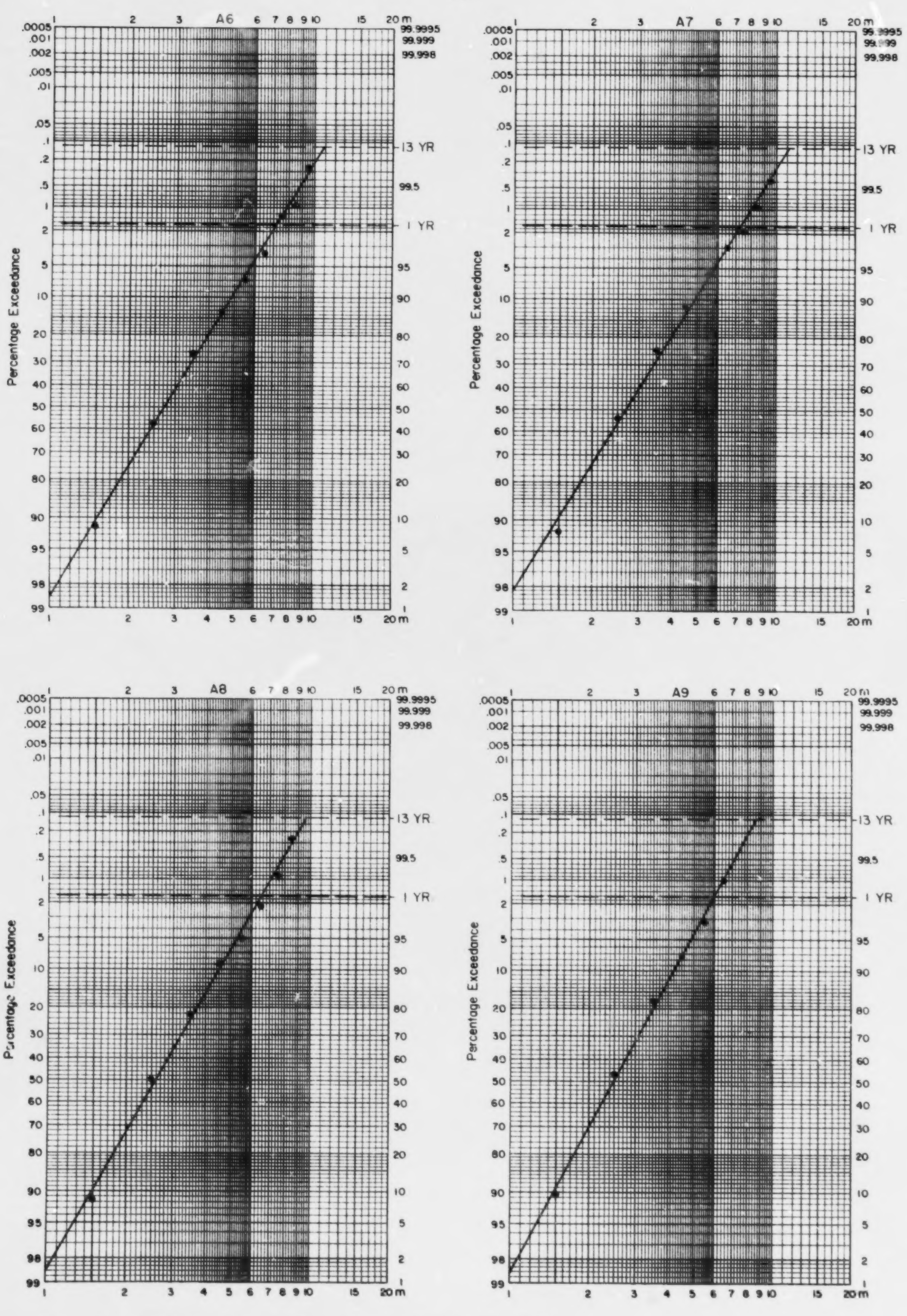


Figure 3d. Monthly Wave Height Exceedance Distribution for March

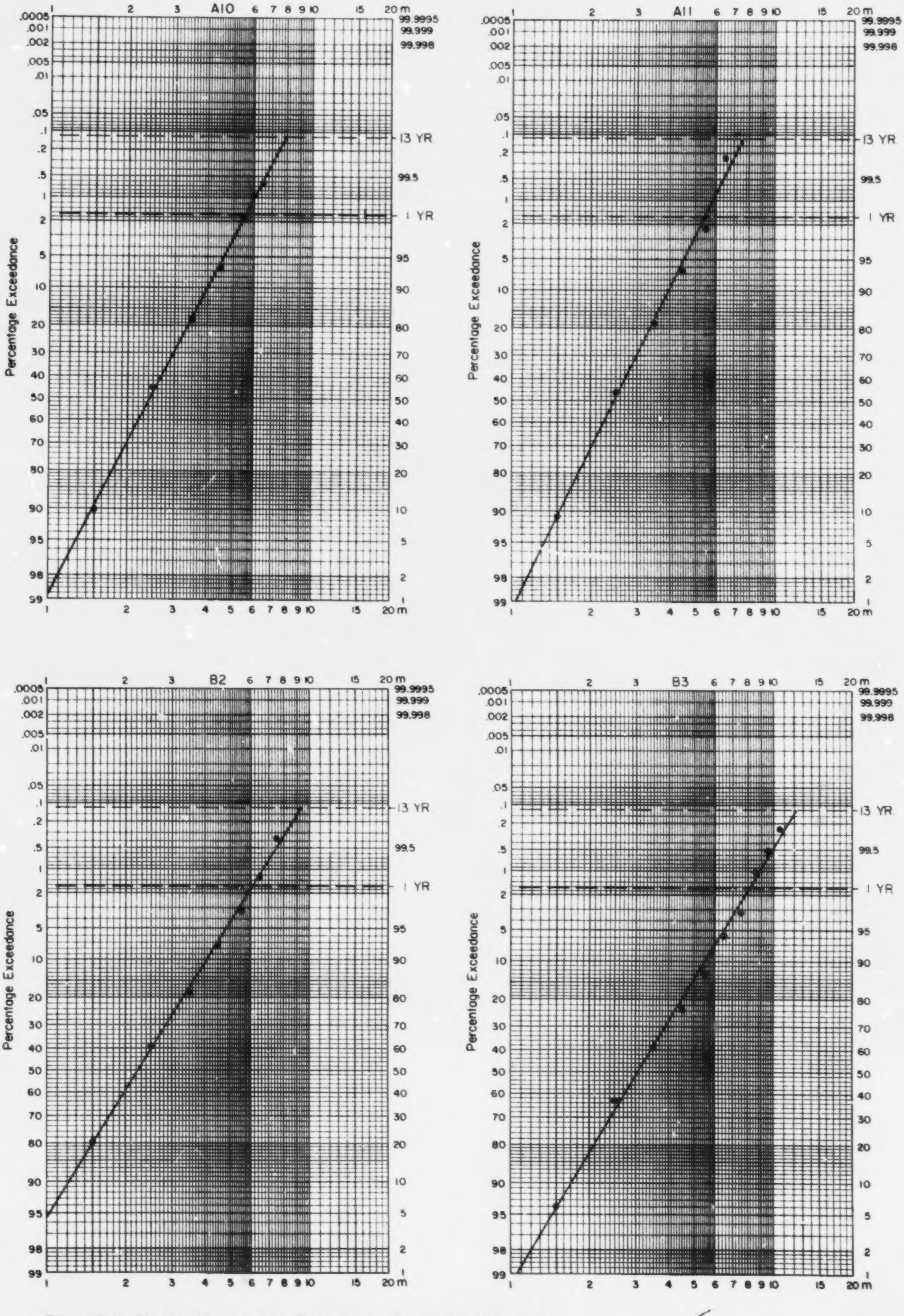


Figure 3e. Monthly Wave Height Exceedance Distribution for March

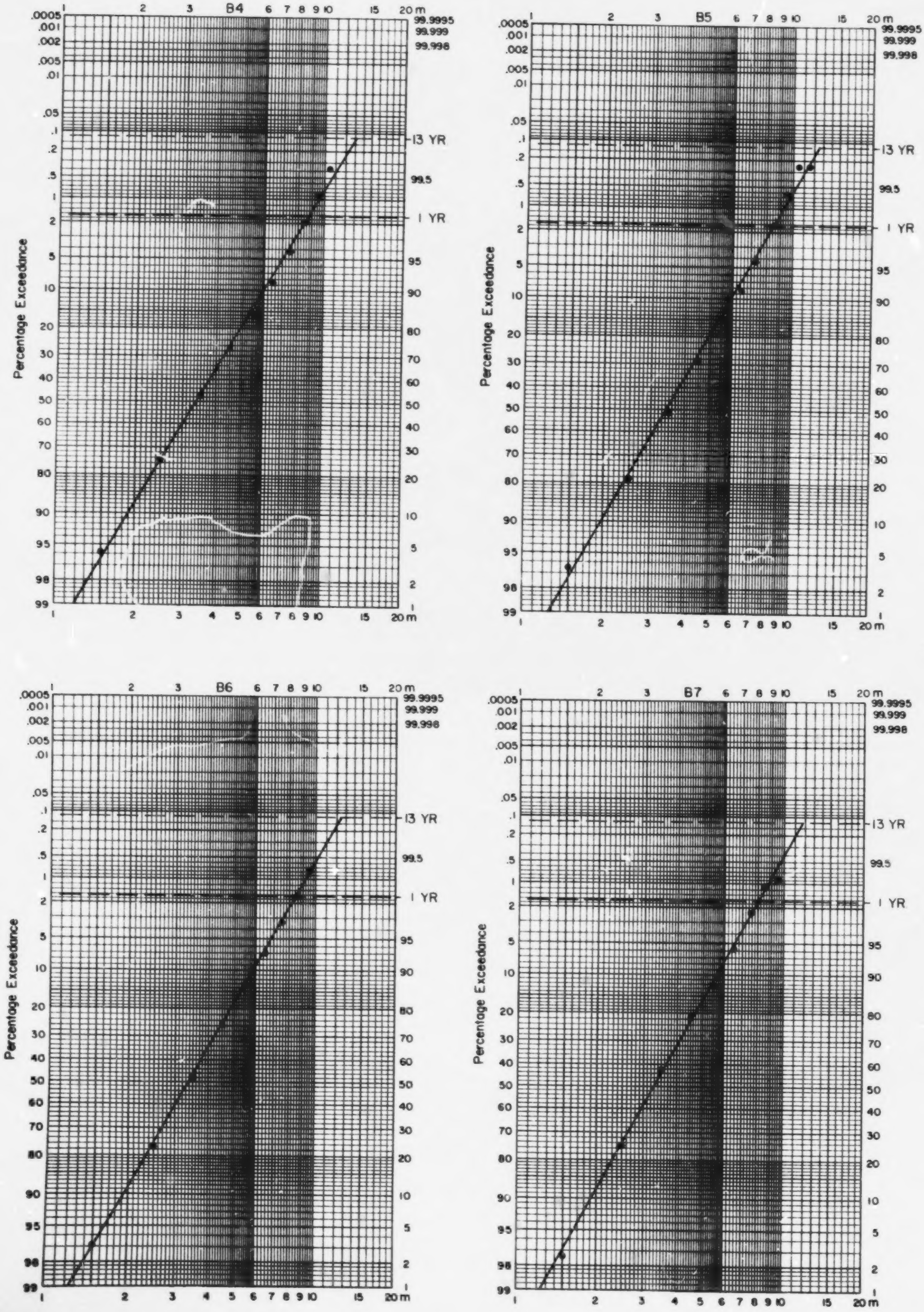


Figure 3f. Monthly Wave Height Exceedance Distribution for March

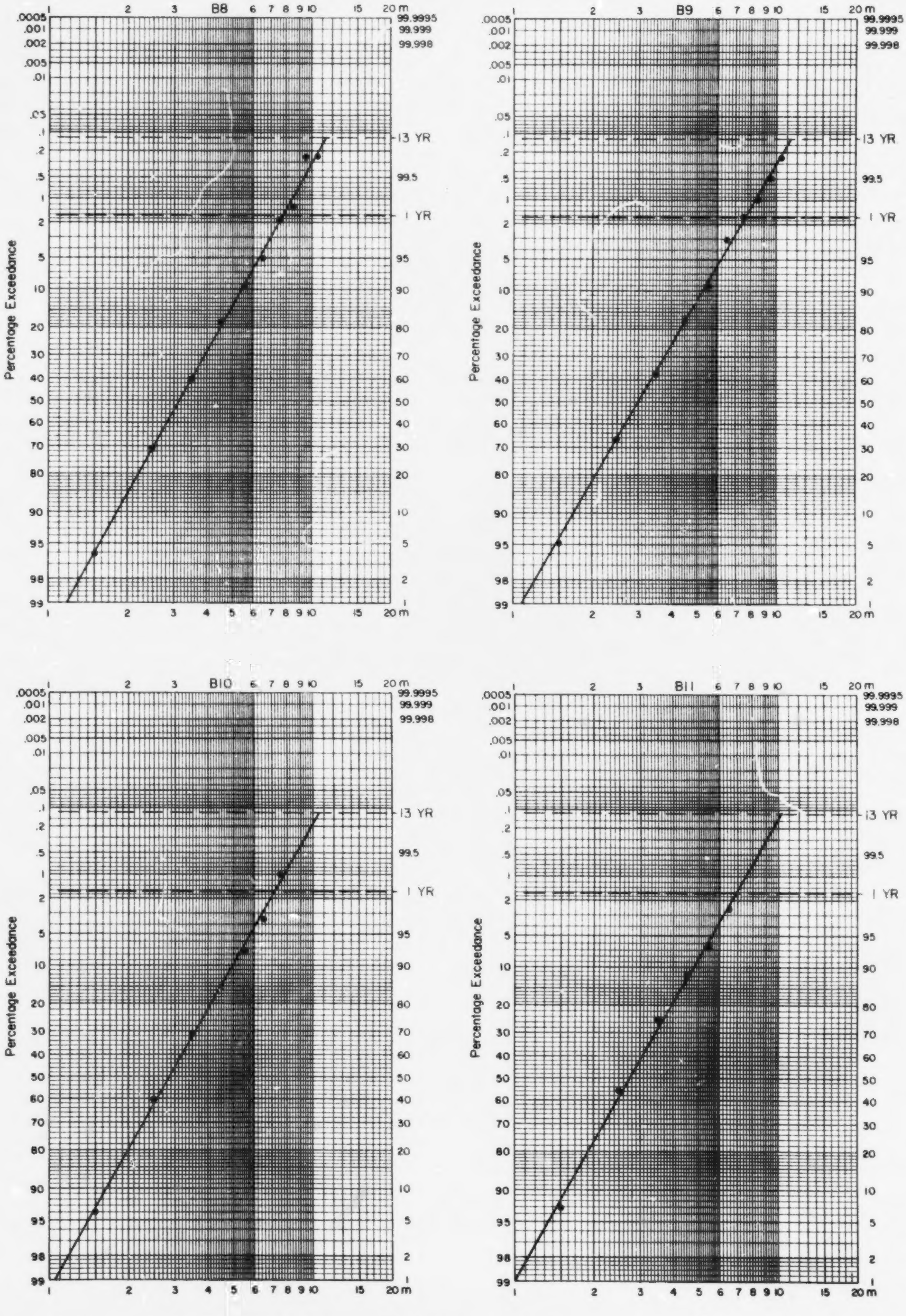


Figure 3g. Monthly Wave Height Exceedance Distribution for March

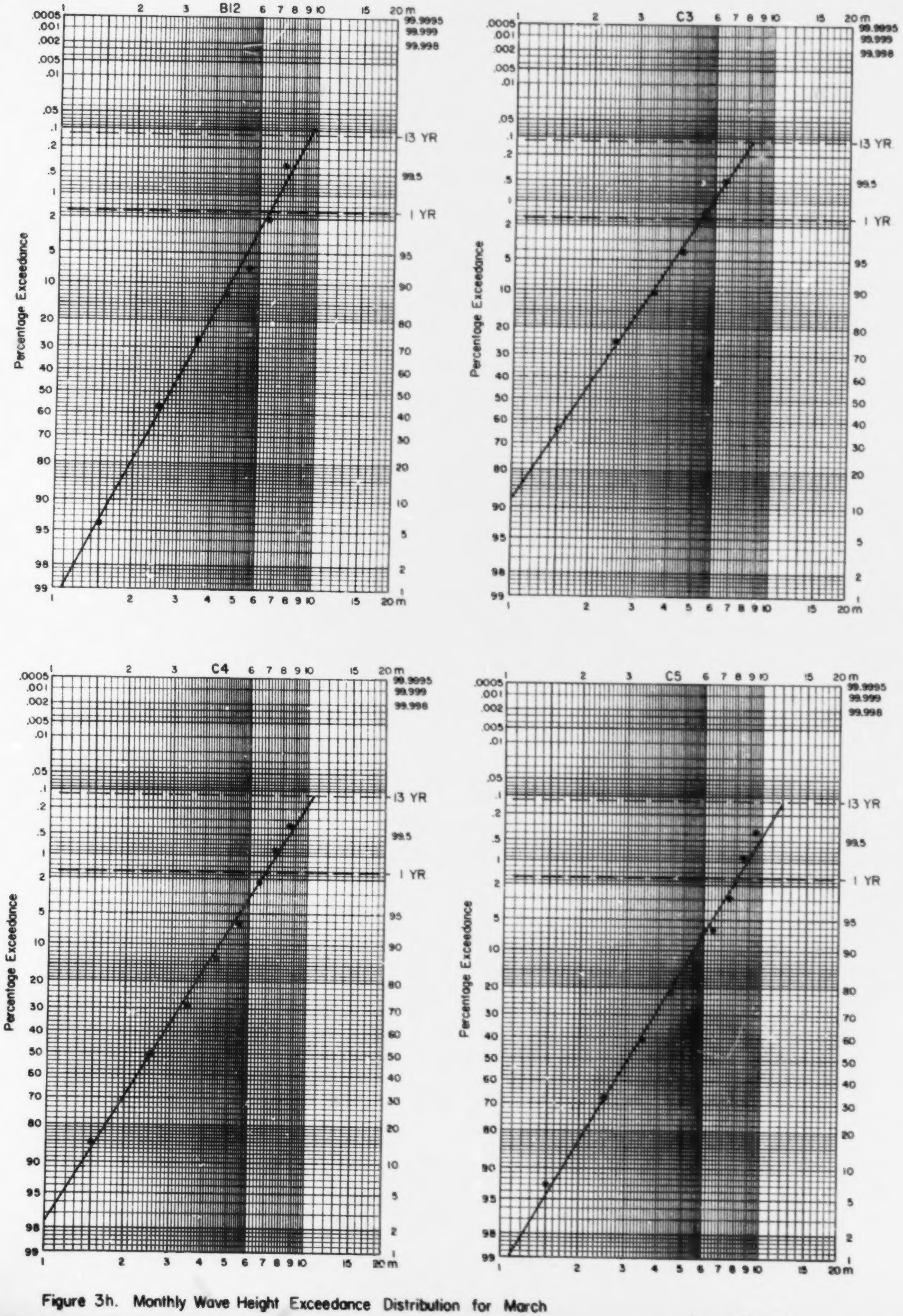


Figure 3h. Monthly Wave Height Exceedance Distribution for March

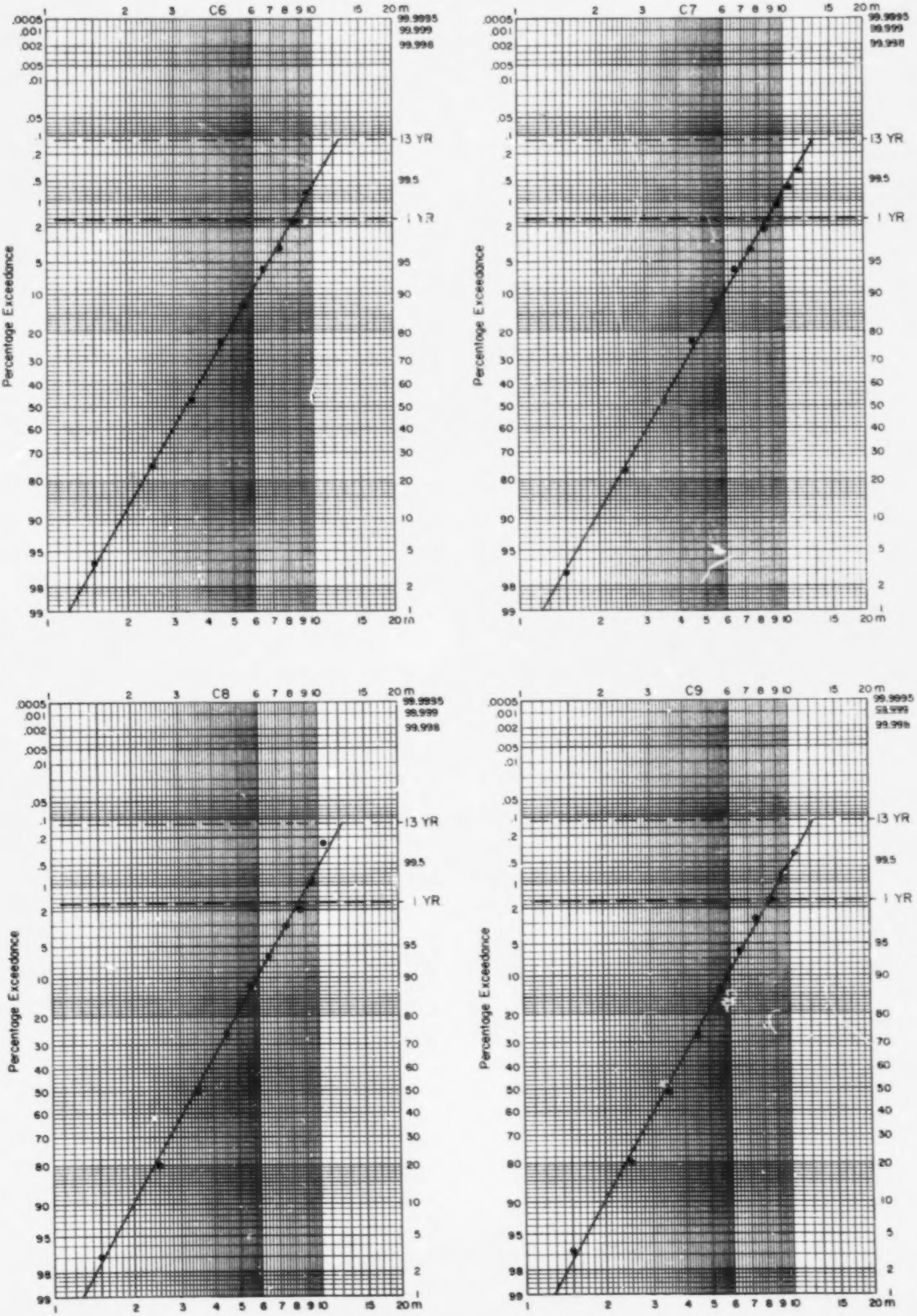


Figure 3i. Monthly Wave Height Exceedance Distribution for March

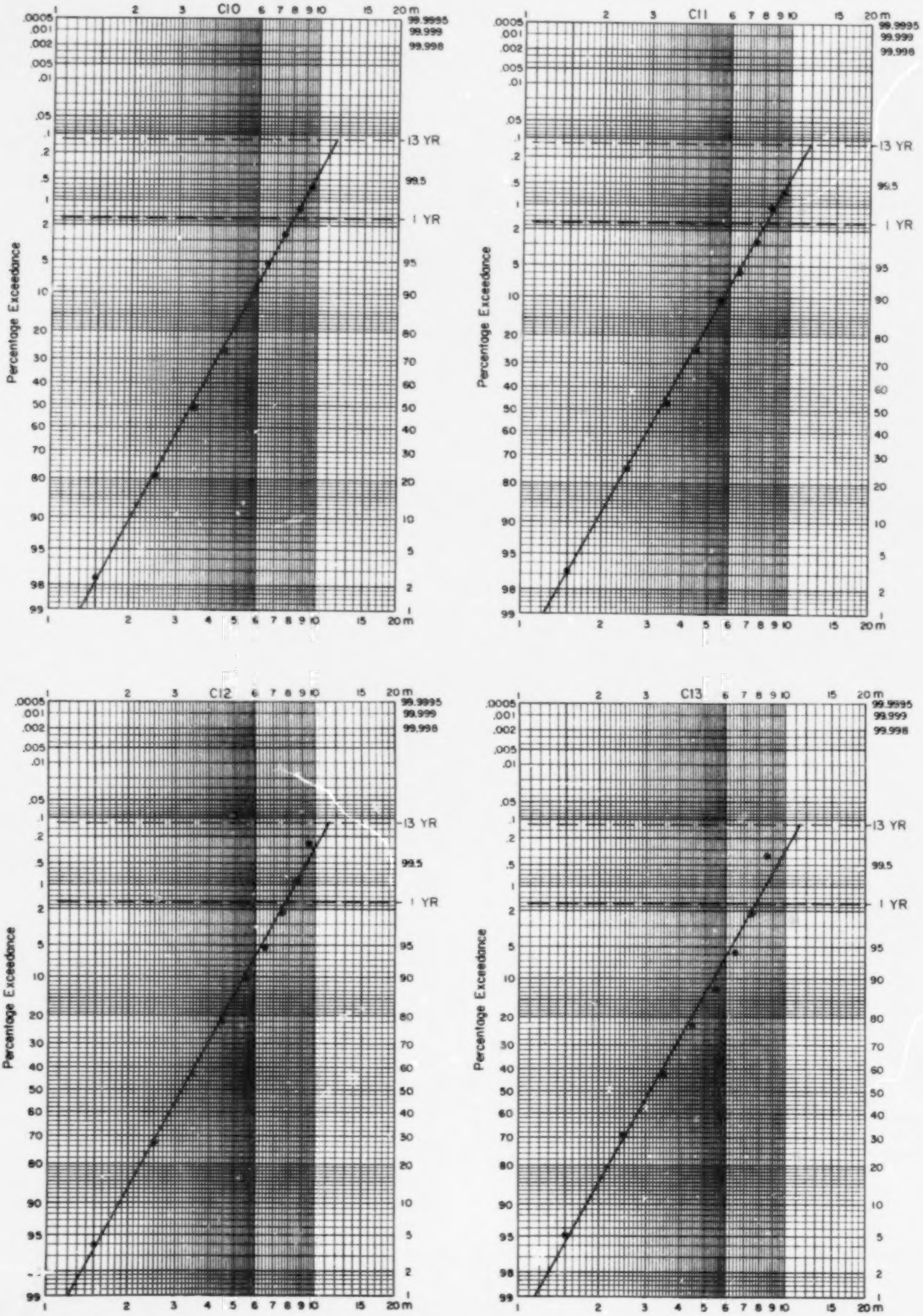


Figure 3j. Monthly Wave Height Exceedance Distribution for March

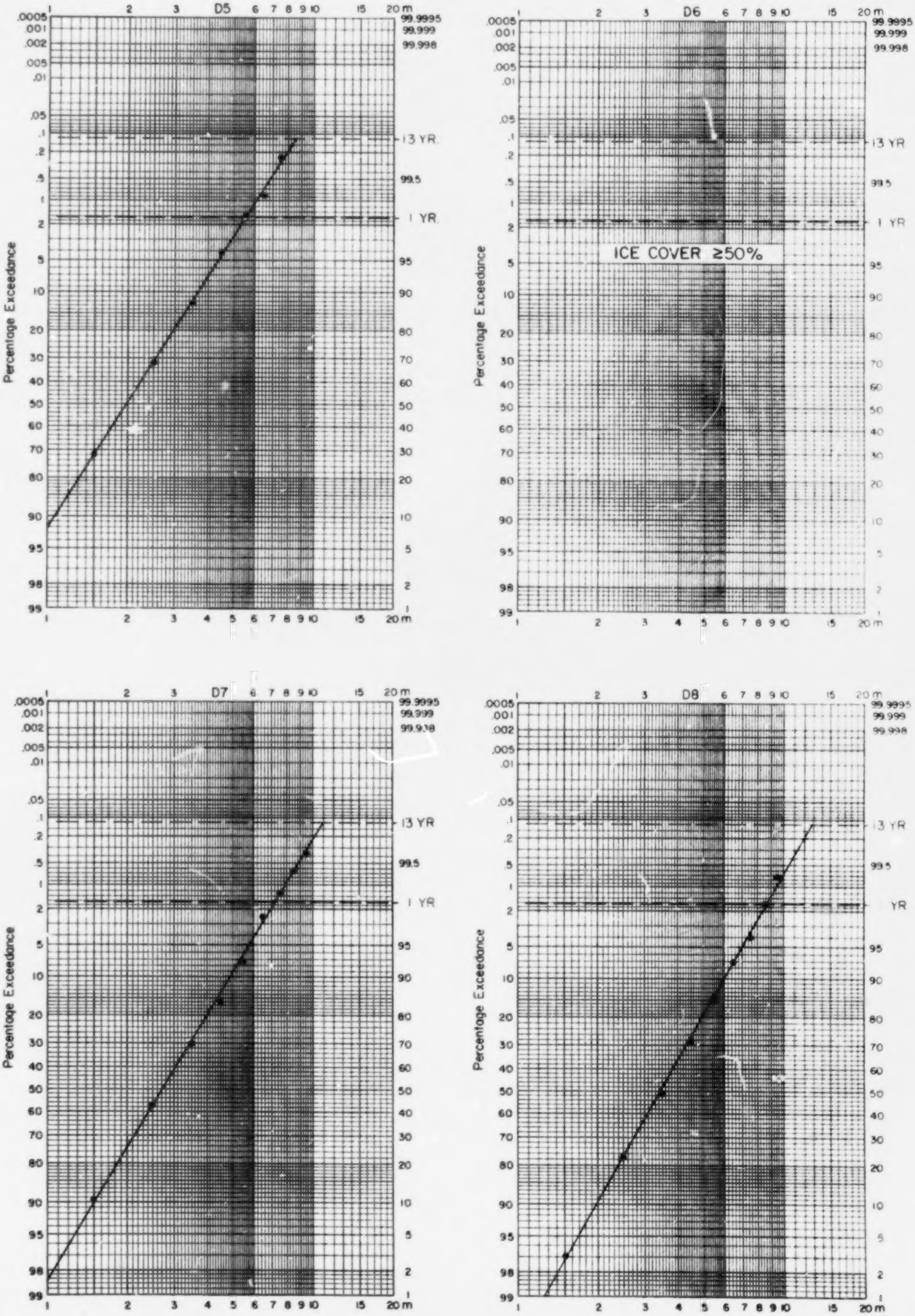


Figure 3k. Monthly Wave Height Exceedance Distribution for March

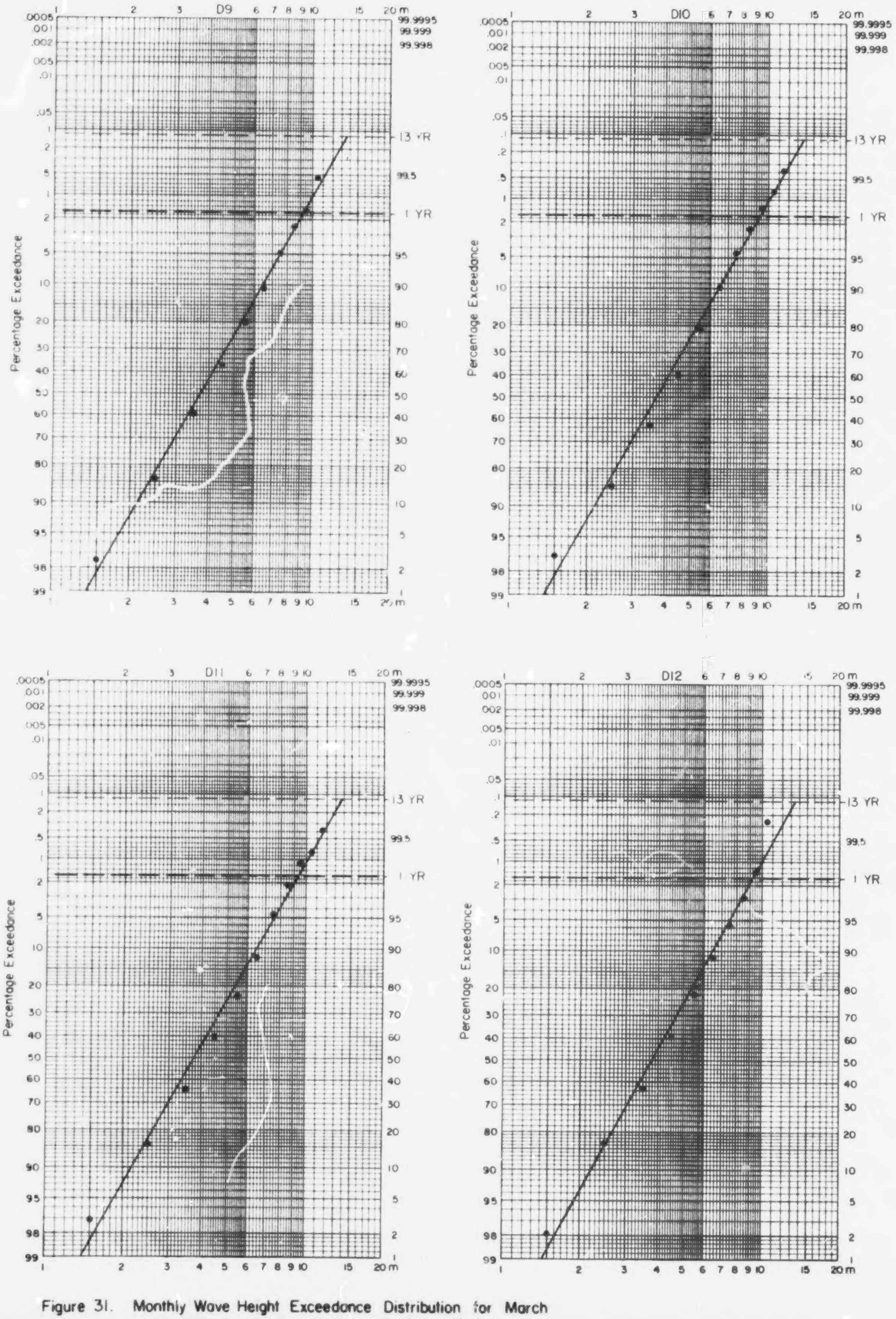


Figure 31. Monthly Wave Height Exceedance Distribution for March

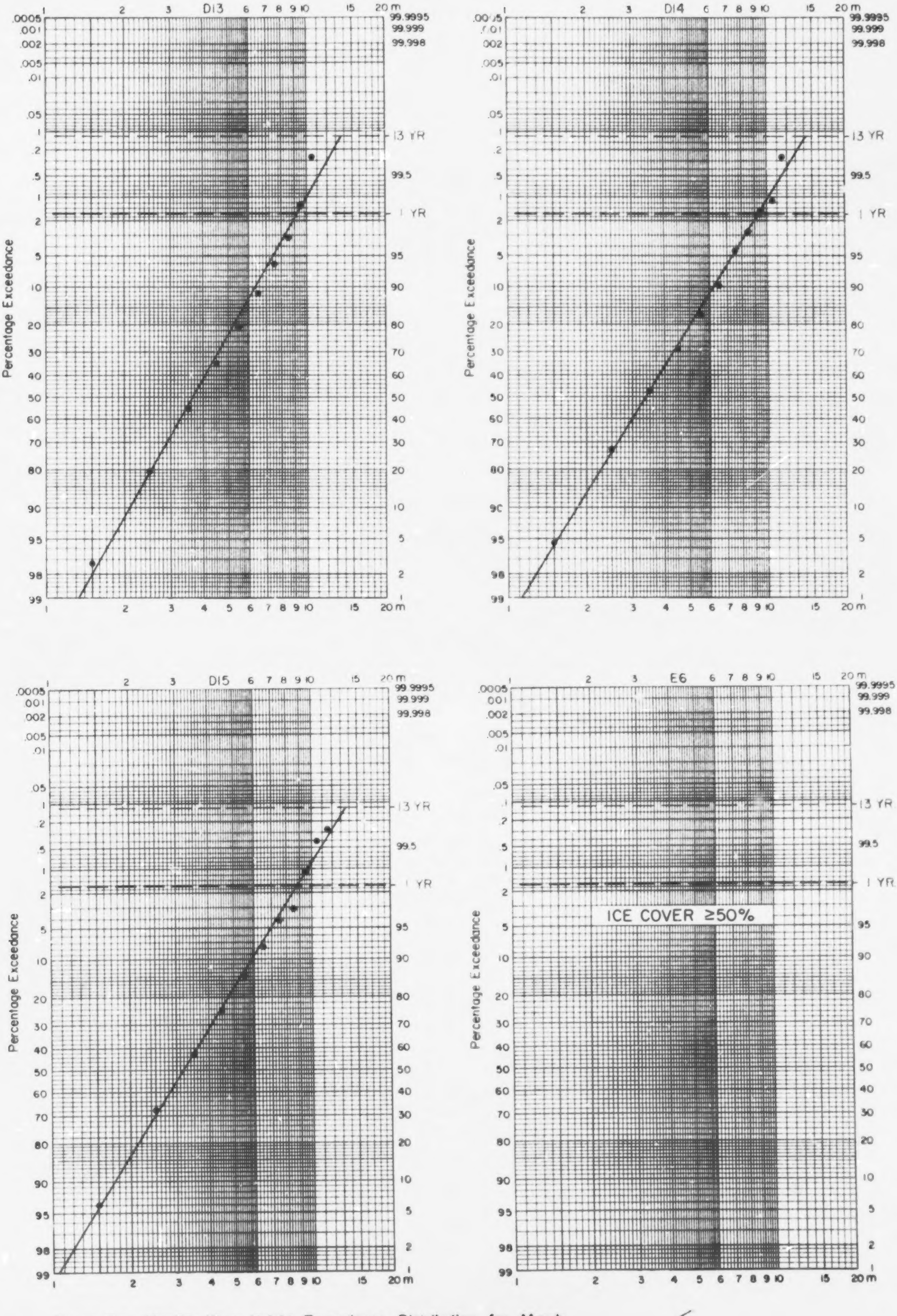


Figure 3m. Monthly Wave Height Exceedance Distribution for March

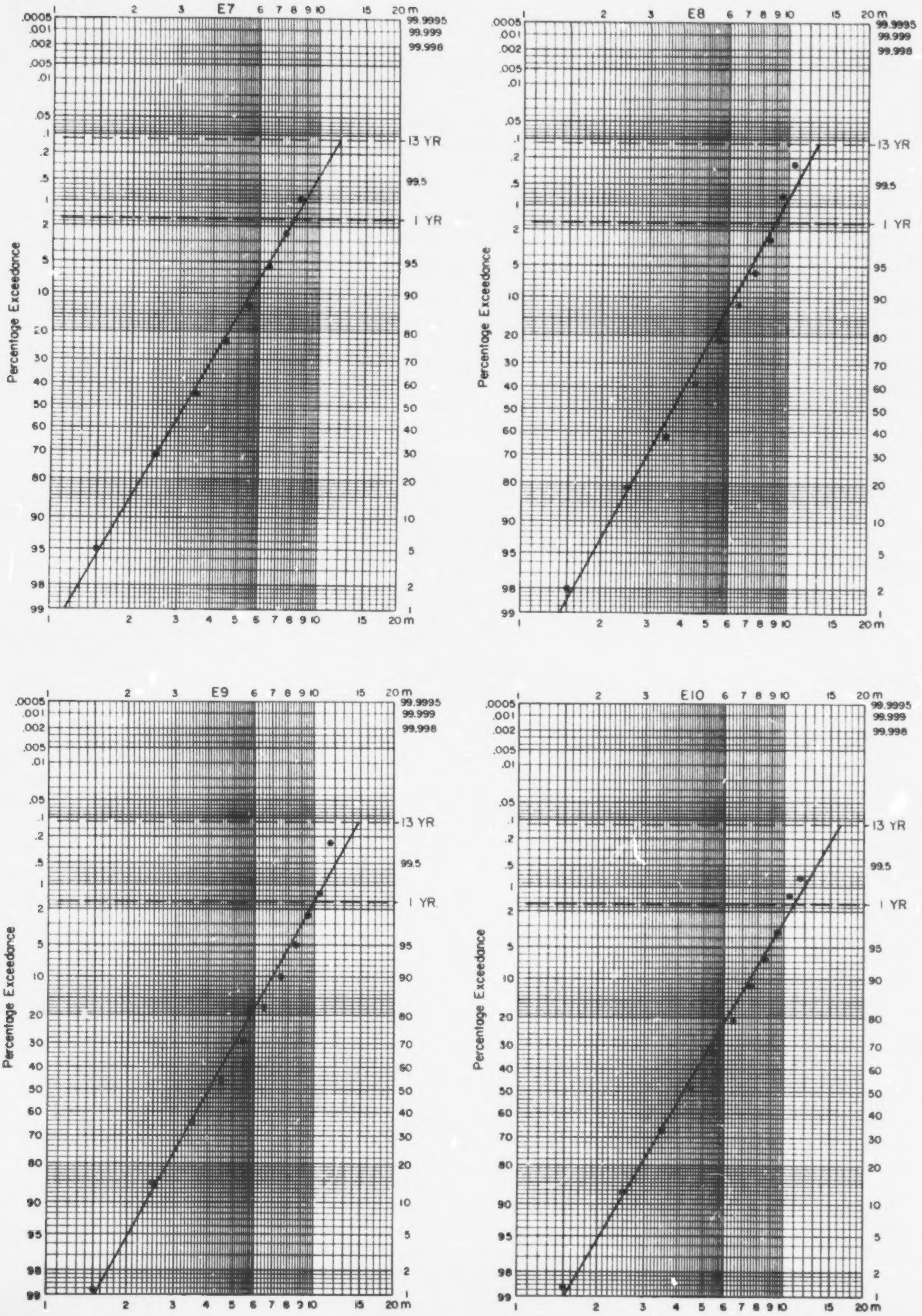


Figure 3n. Monthly Wave Height Exceedance Distribution for March

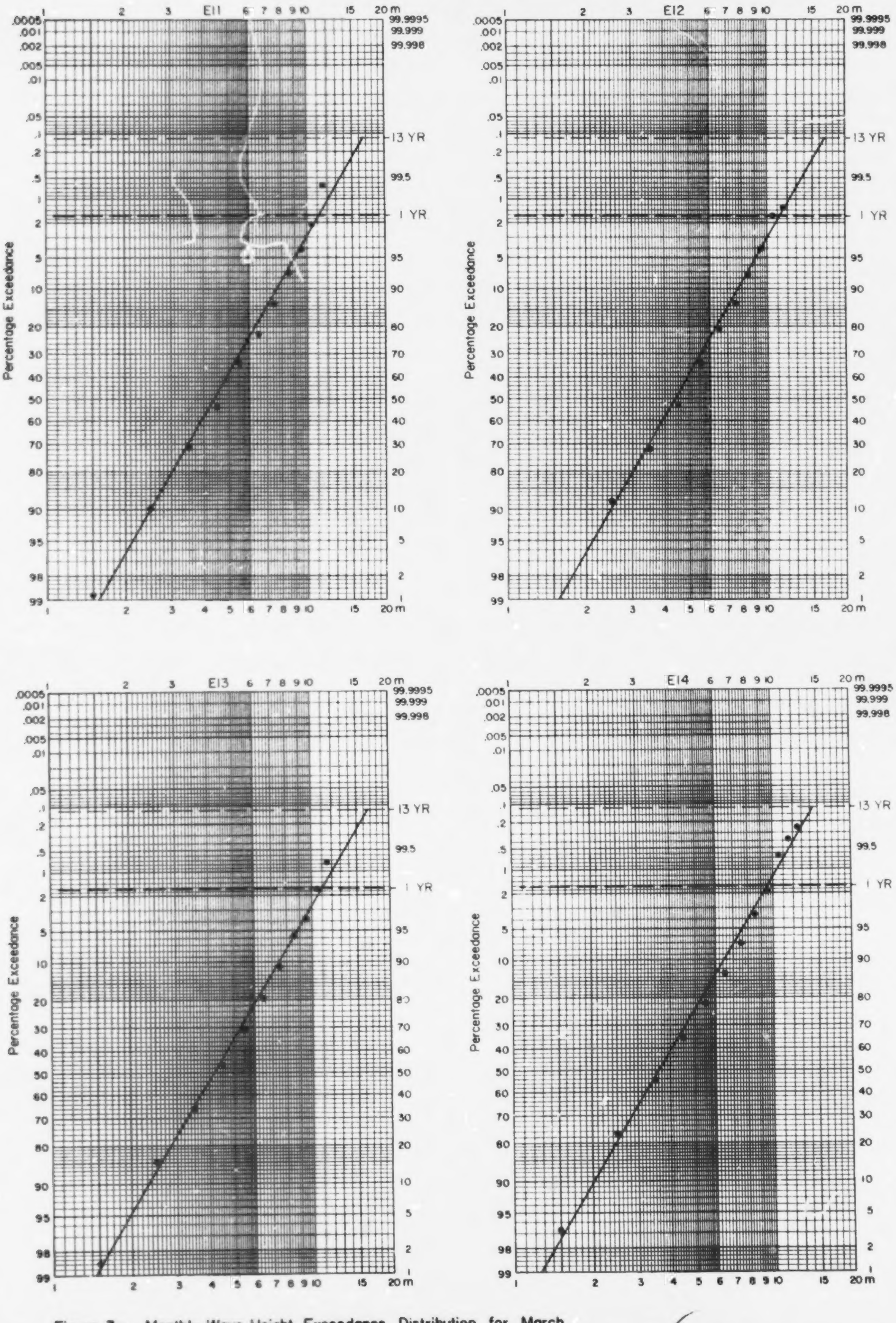


Figure 3o. Monthly Wave Height Exceedance Distribution for March

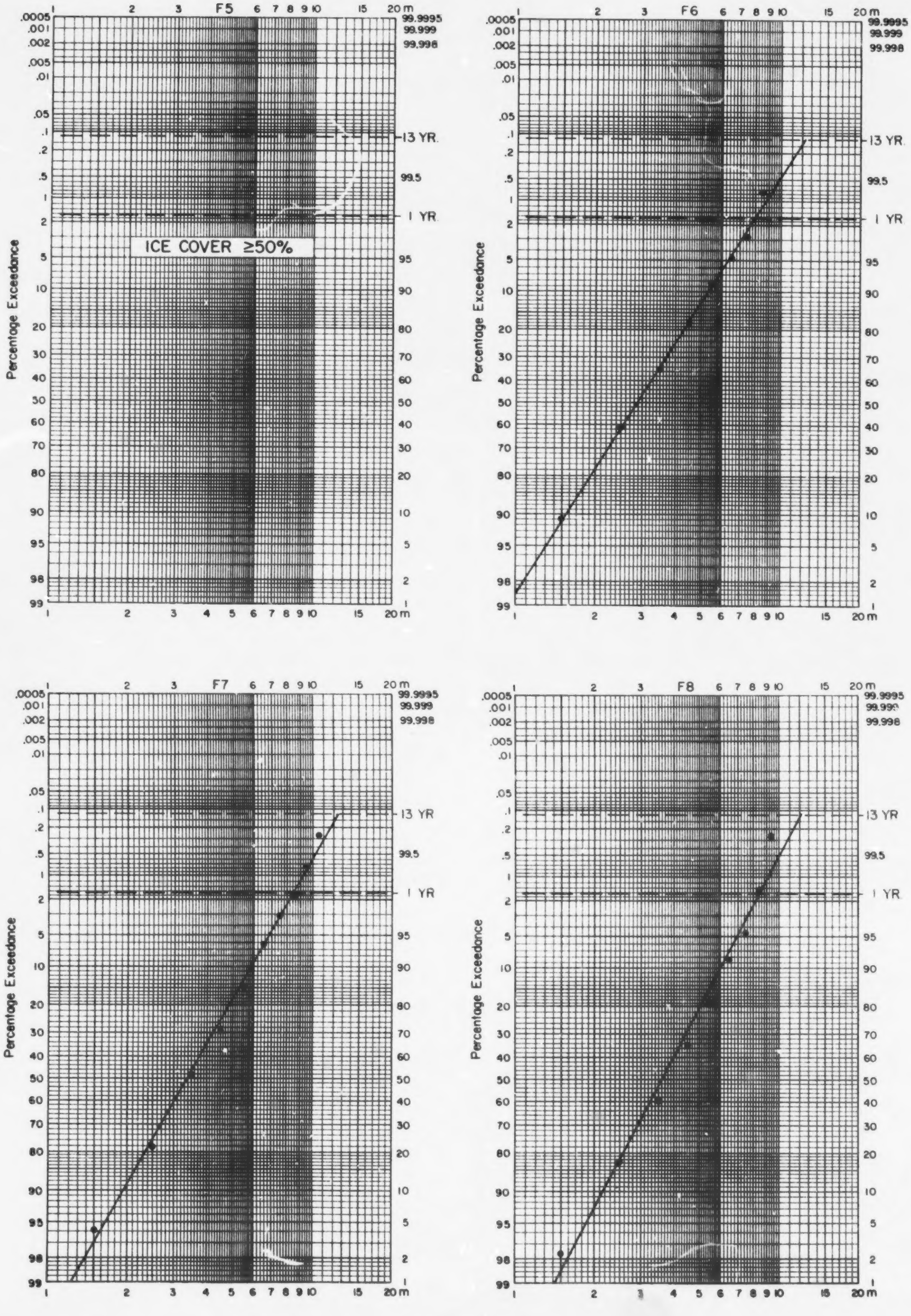


Figure 3p. Monthly Wave Height Exceedance Distribution for March

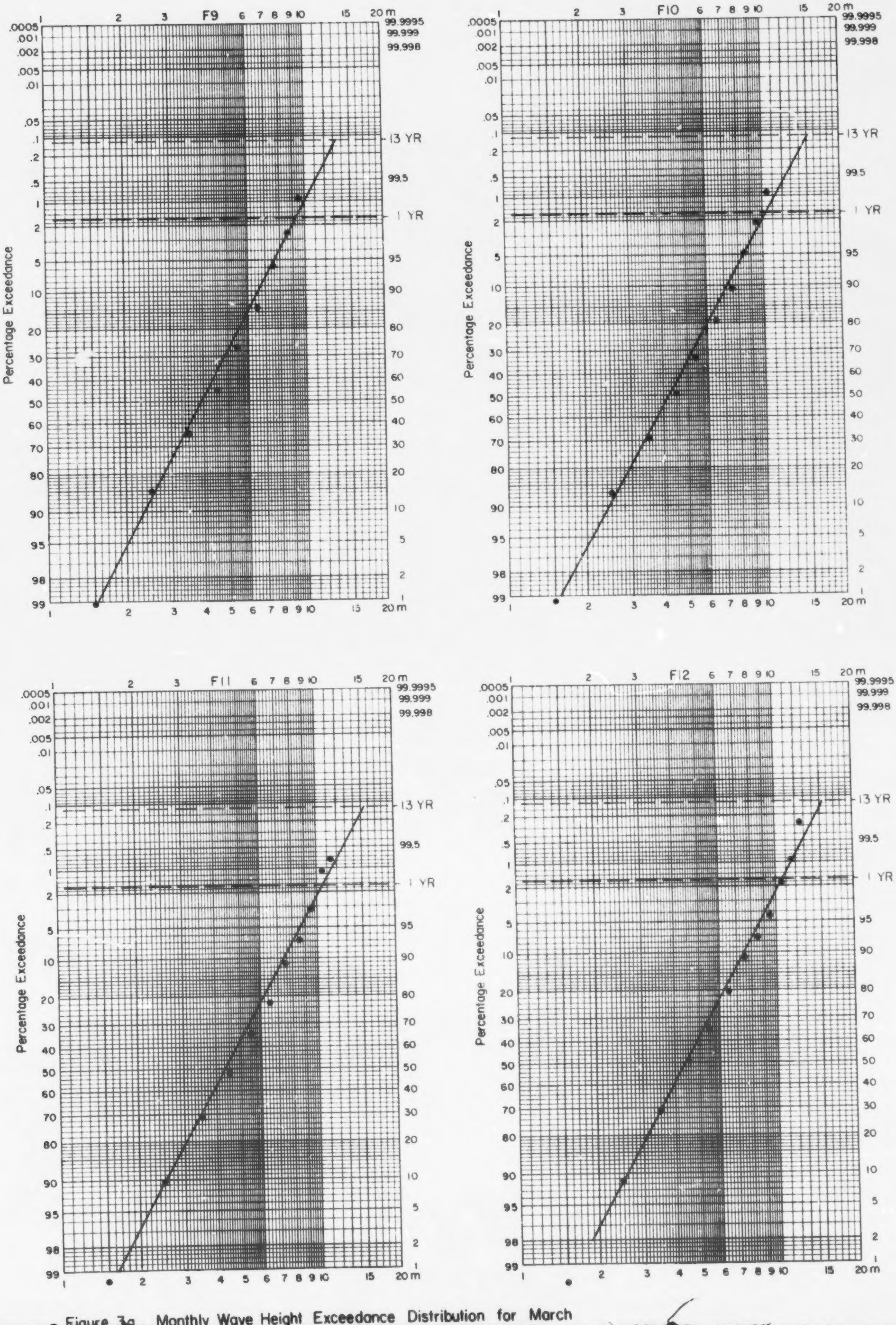


Figure 3a. Monthly Wave Height Exceedance Distribution for March

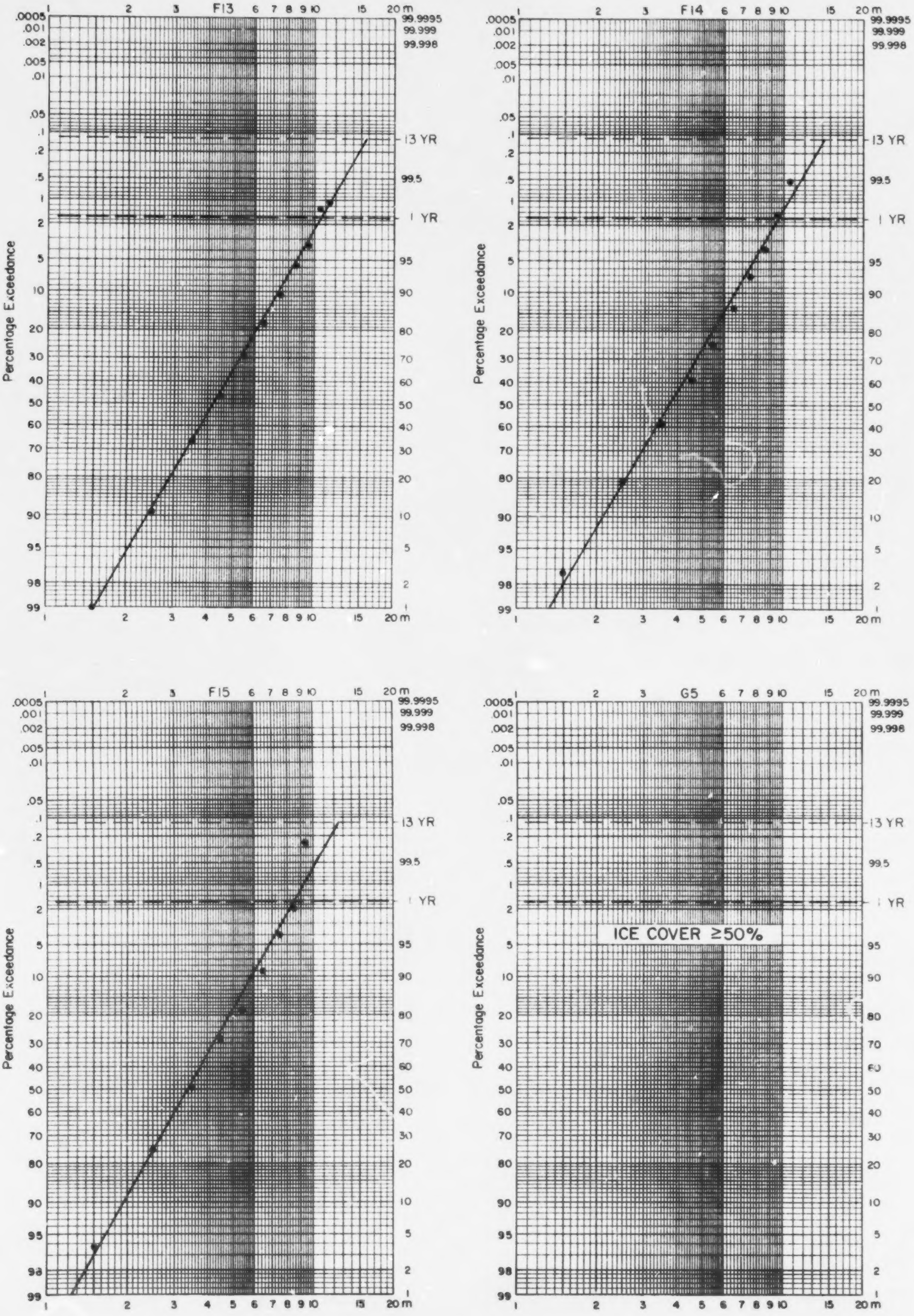


Figure 3r. Monthly Wave Height Exceedance Distribution for March

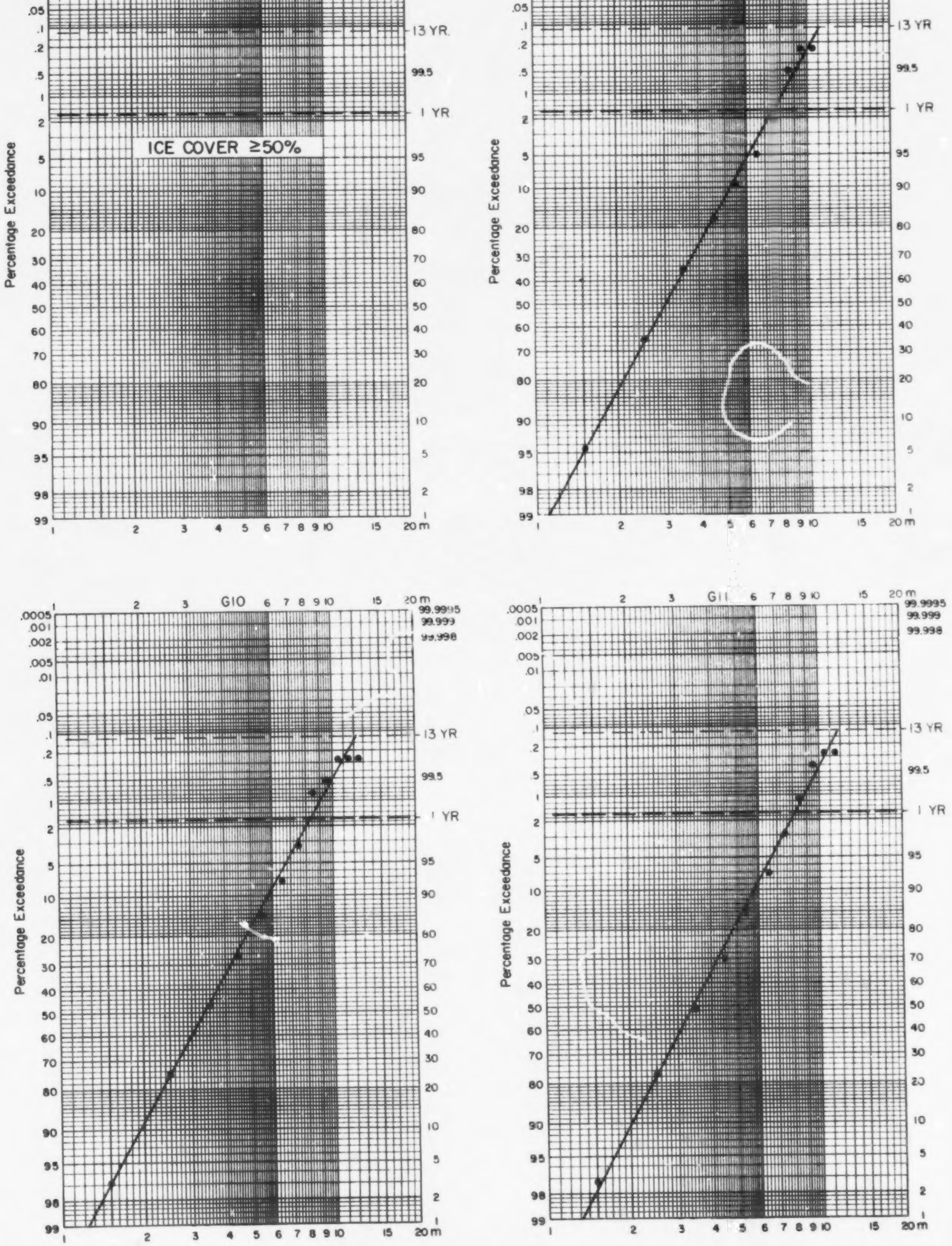


Figure 3s. Monthly Wave Height Exceedance Distribution for March

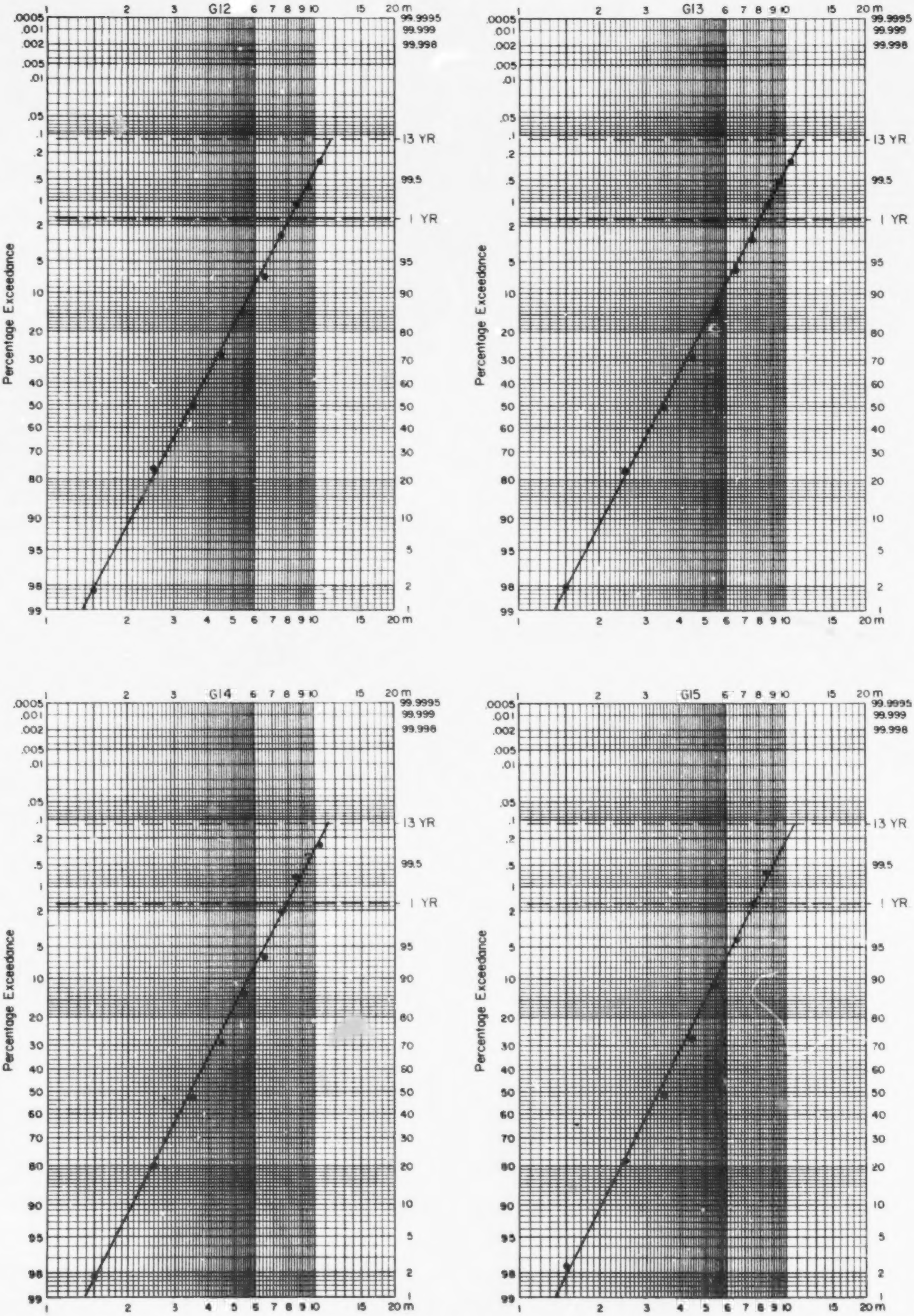


Figure 3t. Monthly Wave Height Exceedance Distribution for March

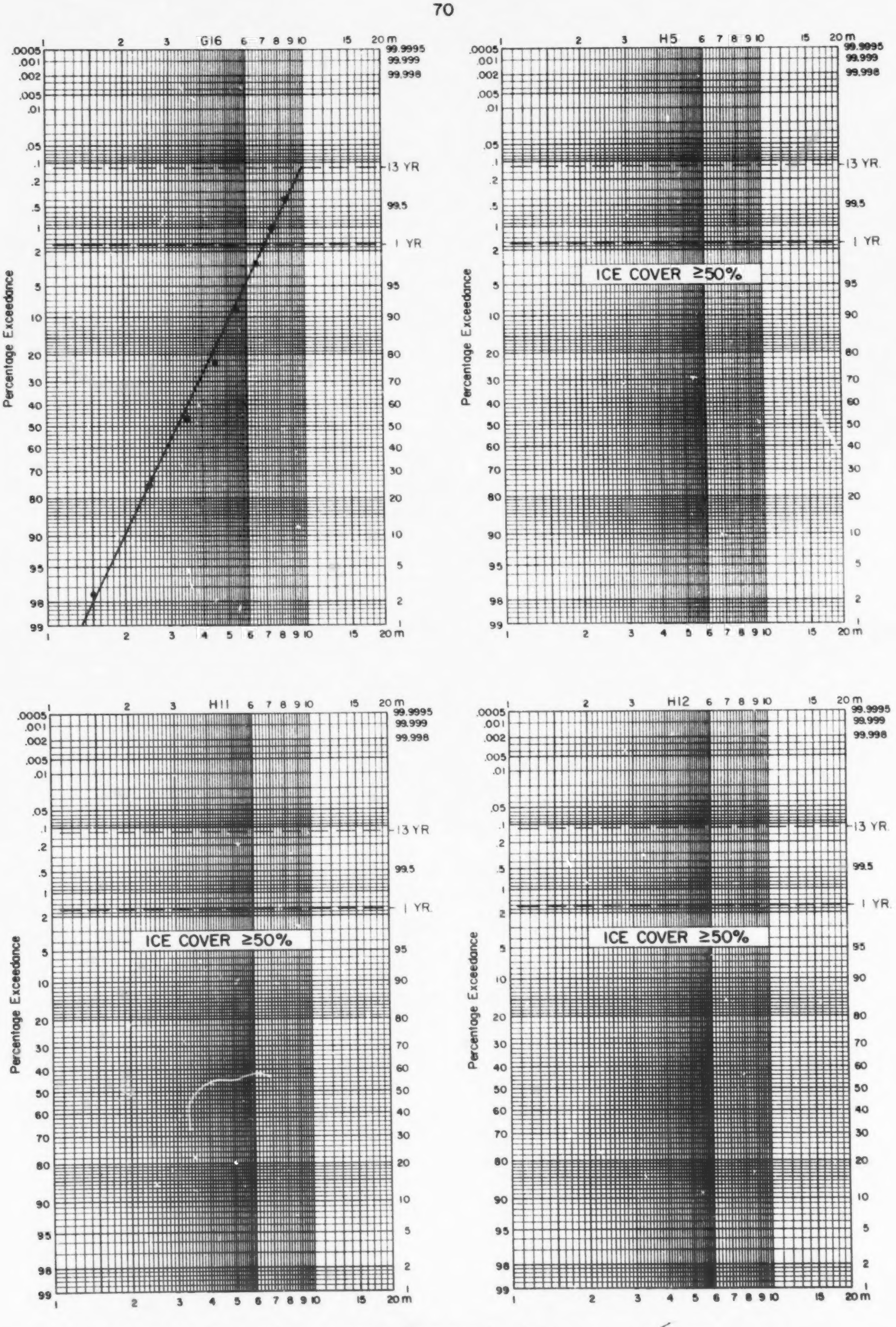
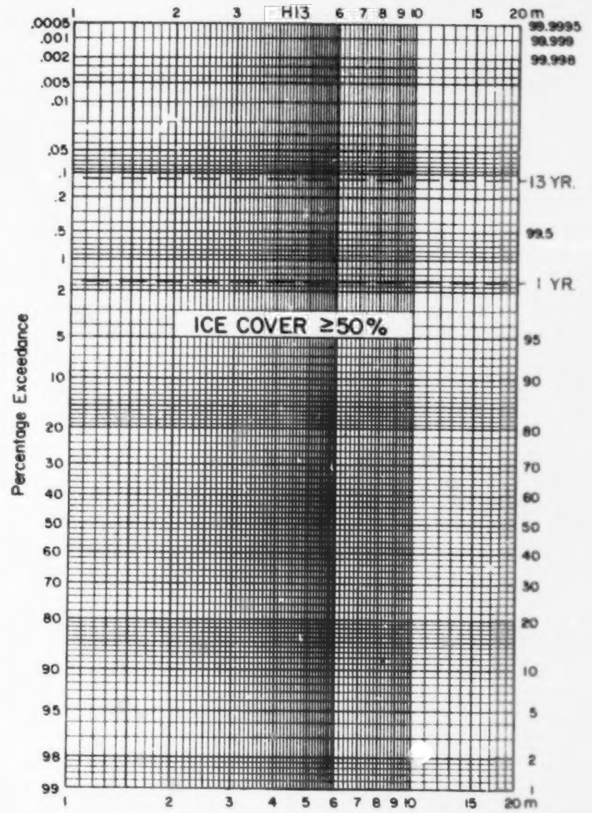
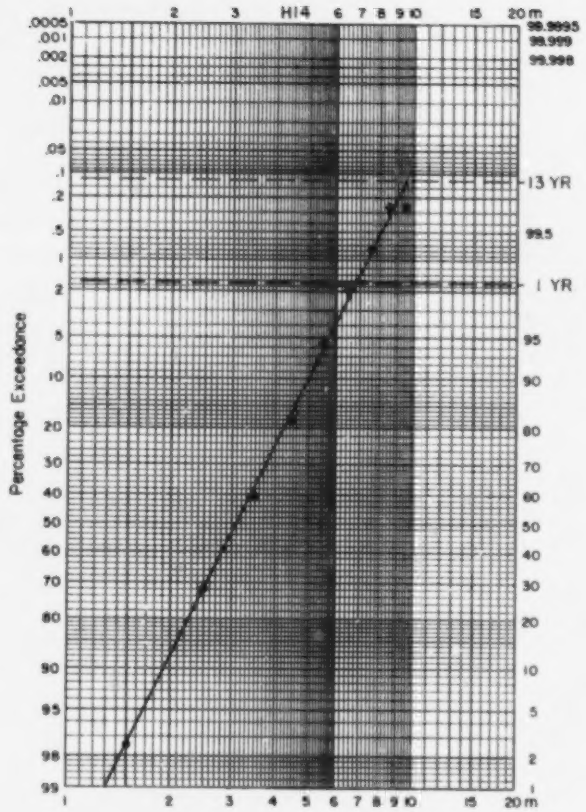
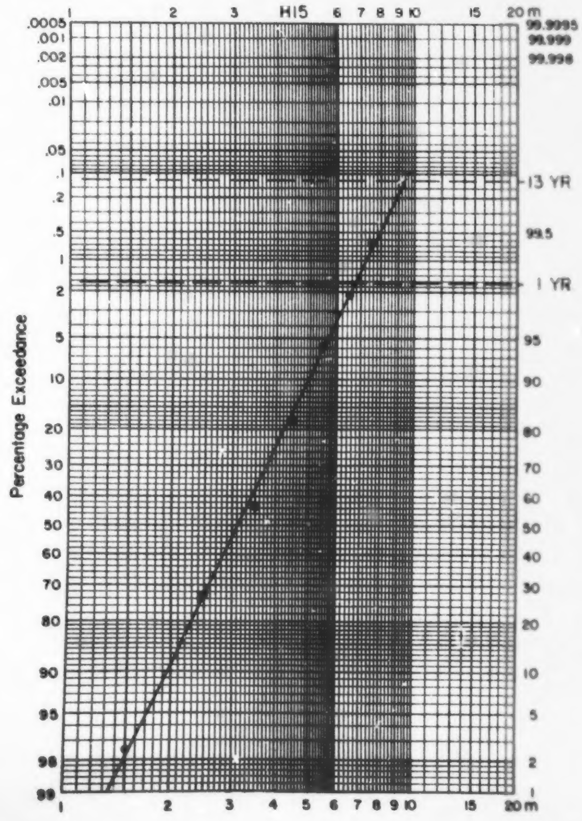


Figure 3u. Monthly Wave Height Exceedance Distribution for March







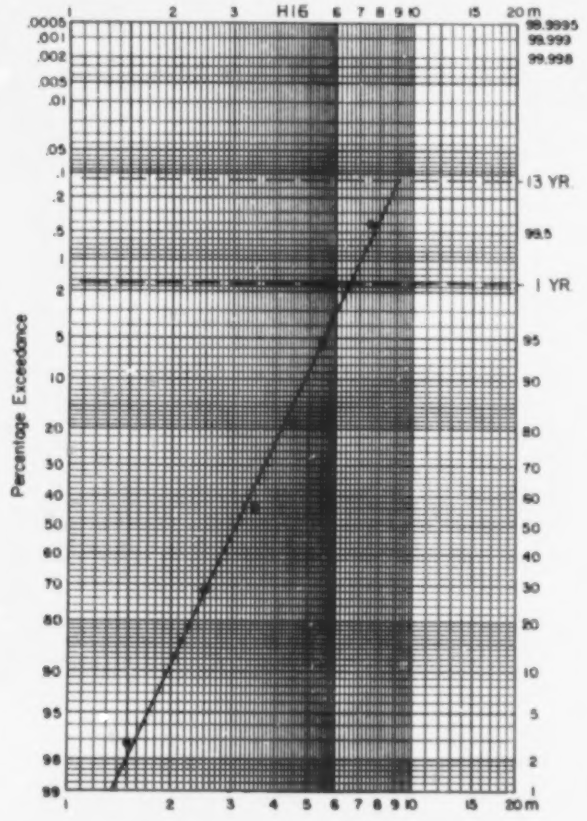


Figure 3v. Monthly Wave Height Exceedance Distribution for March

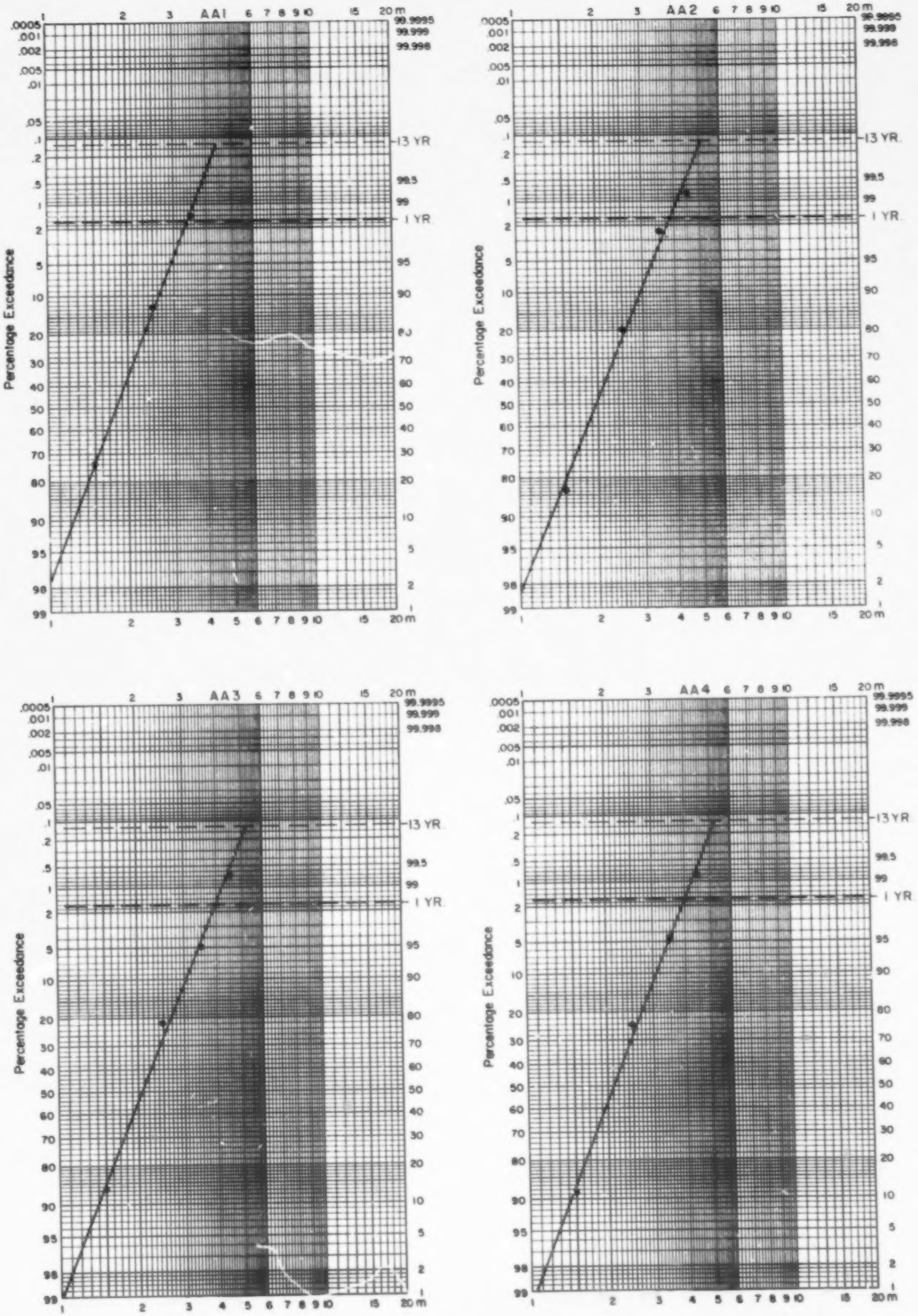


Figure 4a. Monthly Wave Height Exceedance Distribution for April

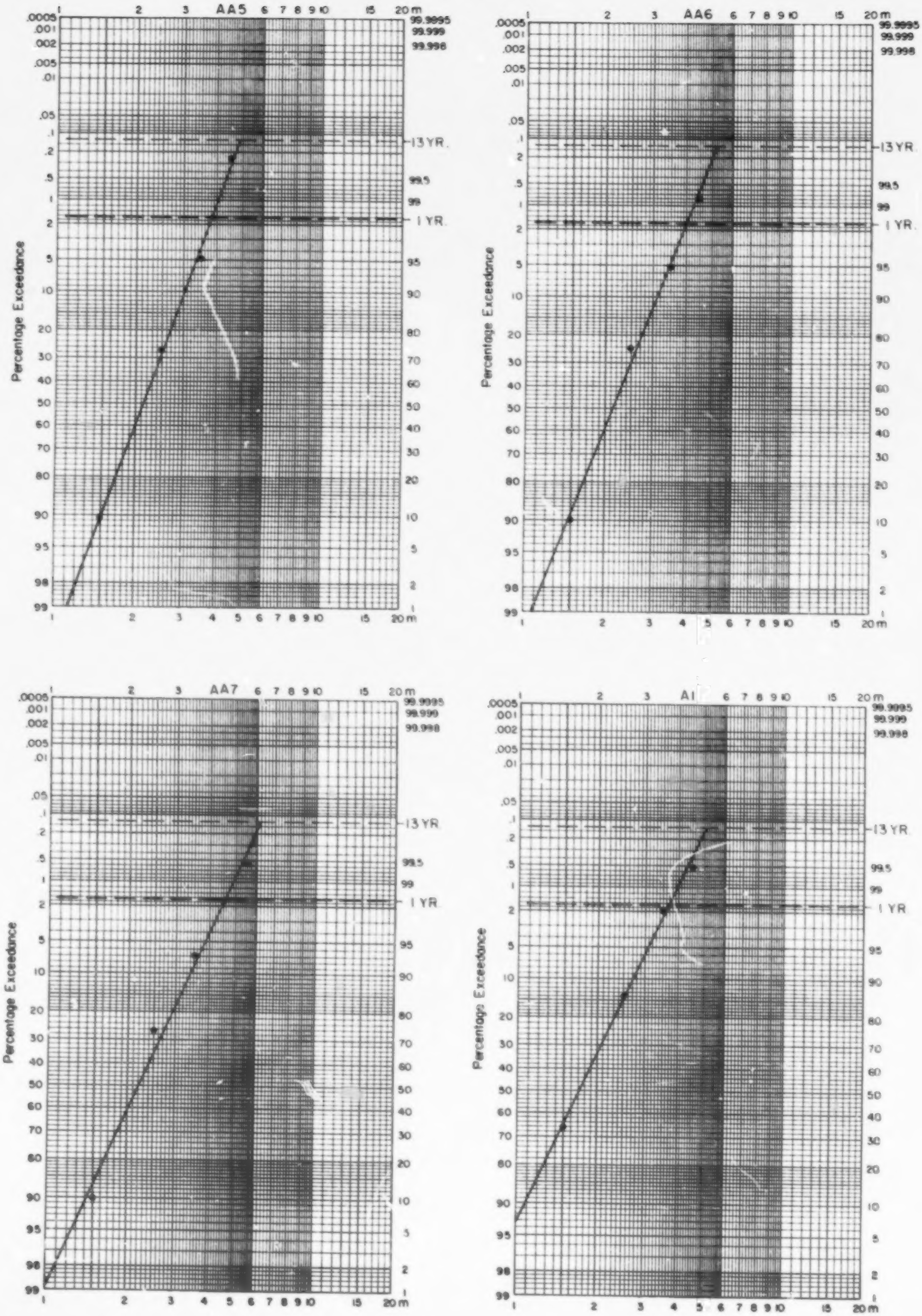


Figure 4b. Monthly Wave Height Exceedance Distribution for April

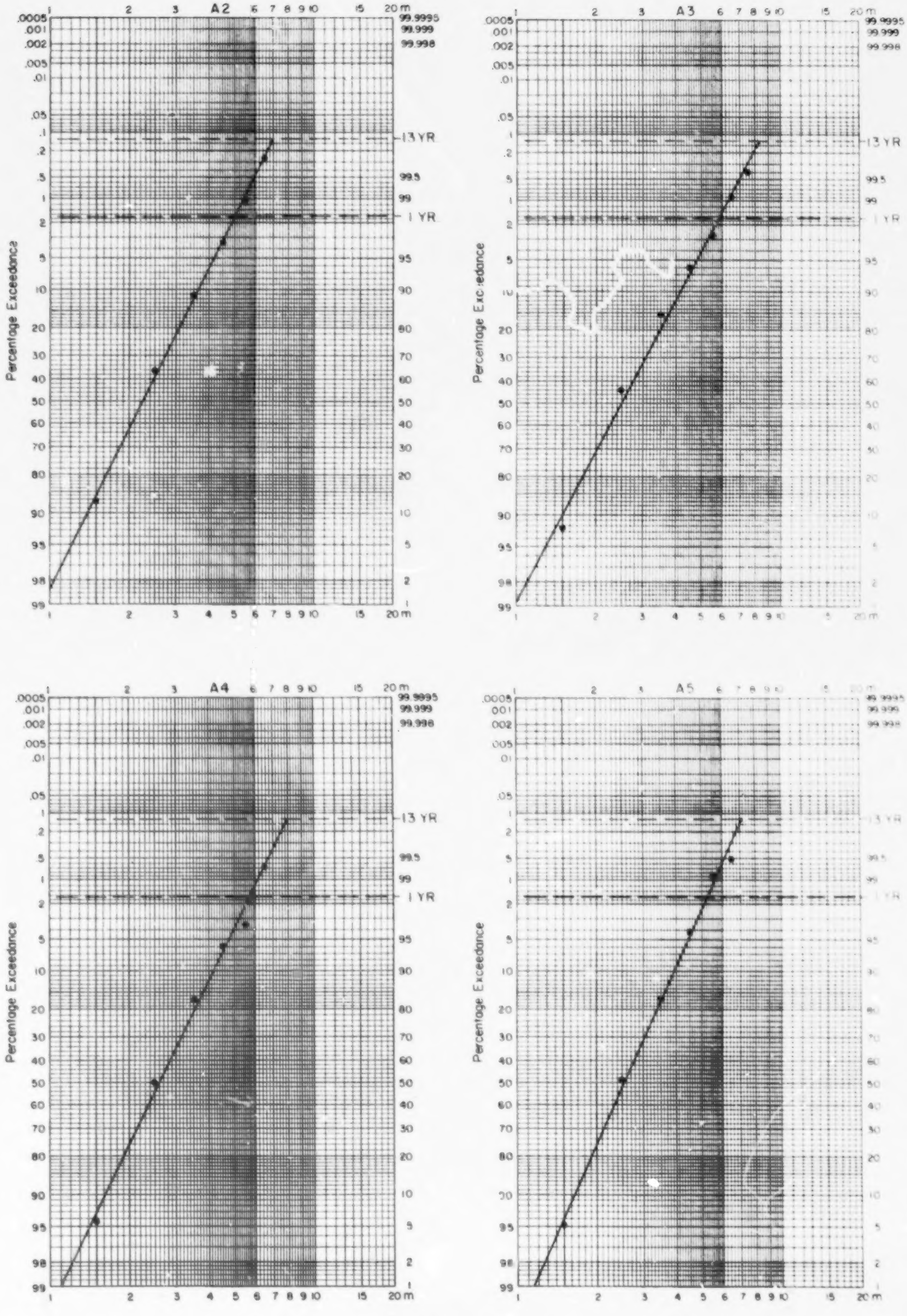


Figure 4c. Monthly Wave Height Exceedance Distribution for April

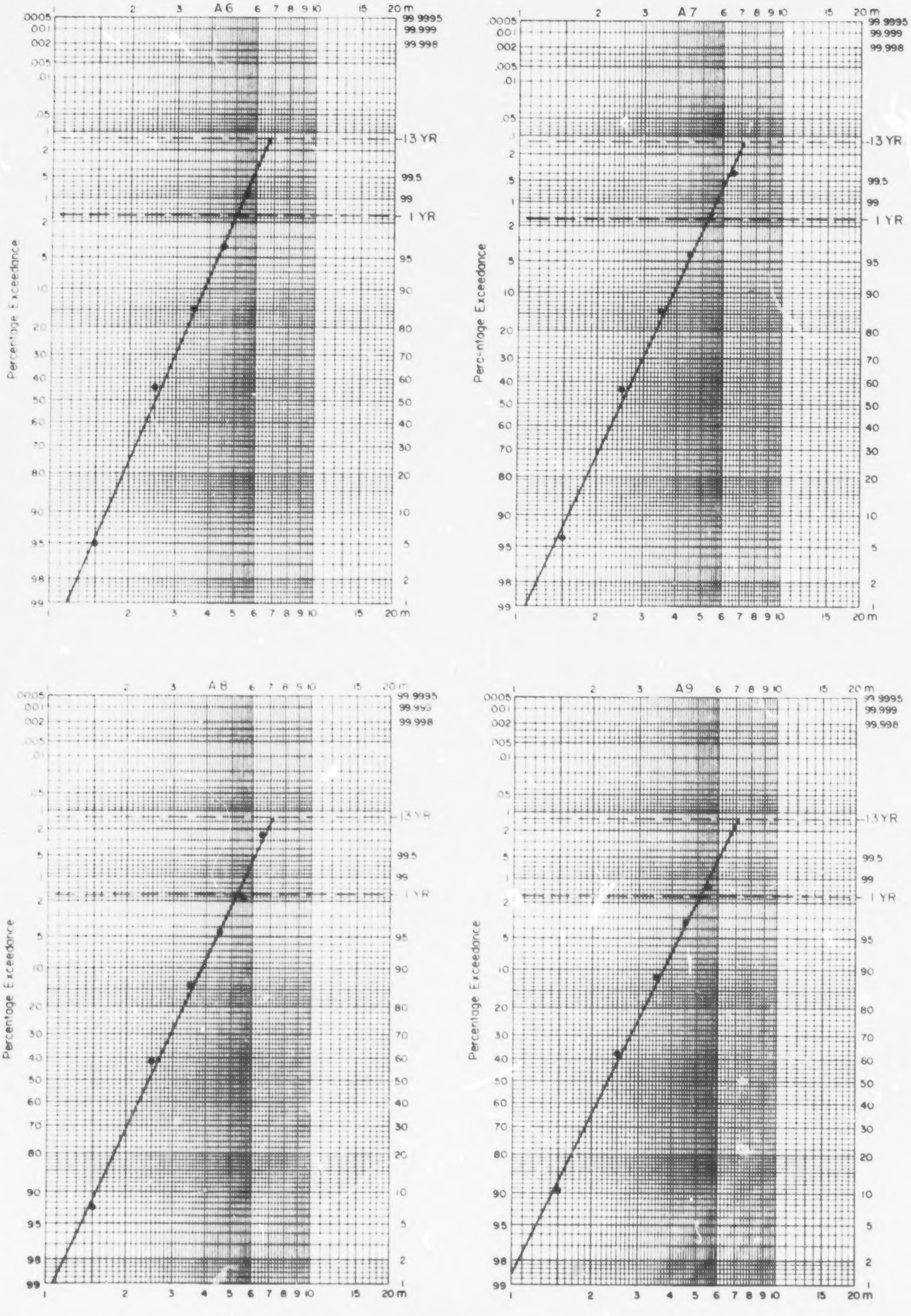


Figure 4d. Monthly Wave Height Exceedance Distribution for April

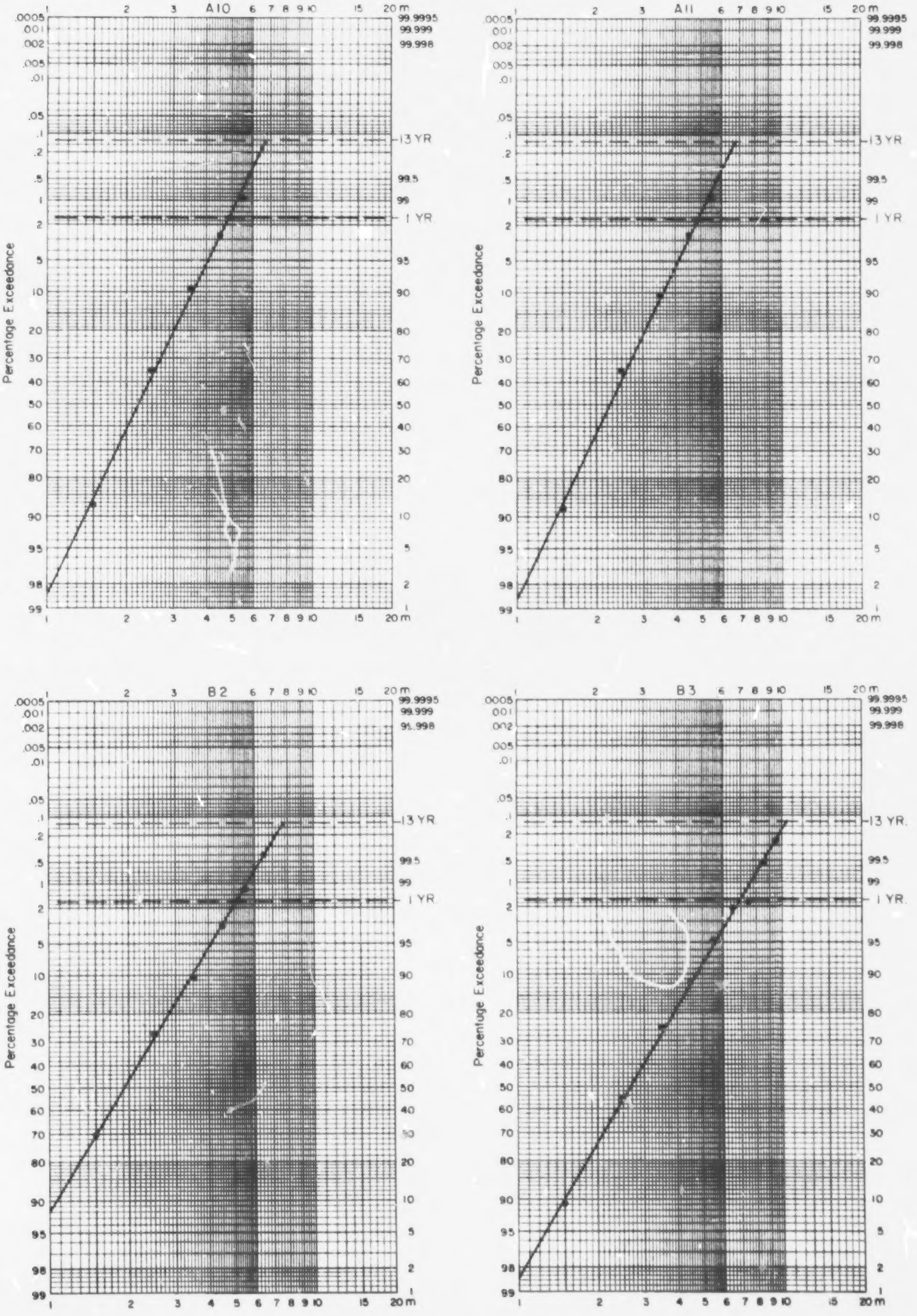
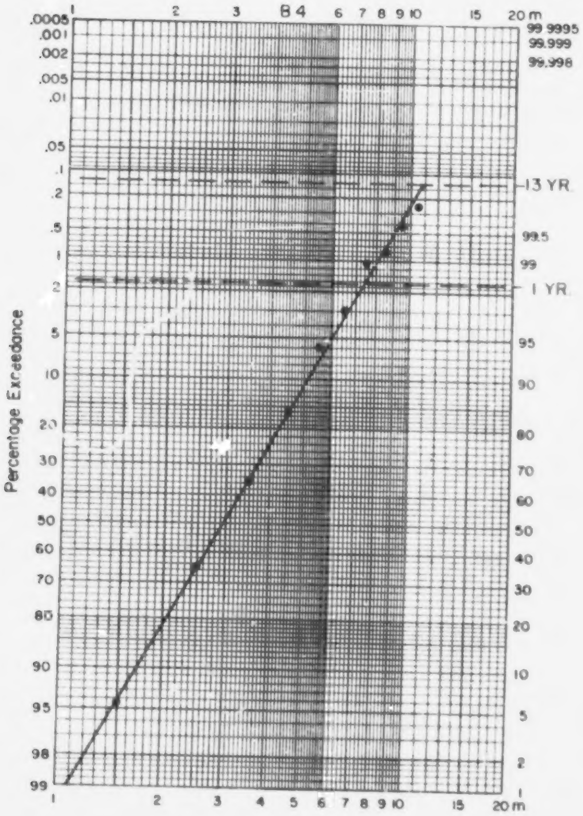
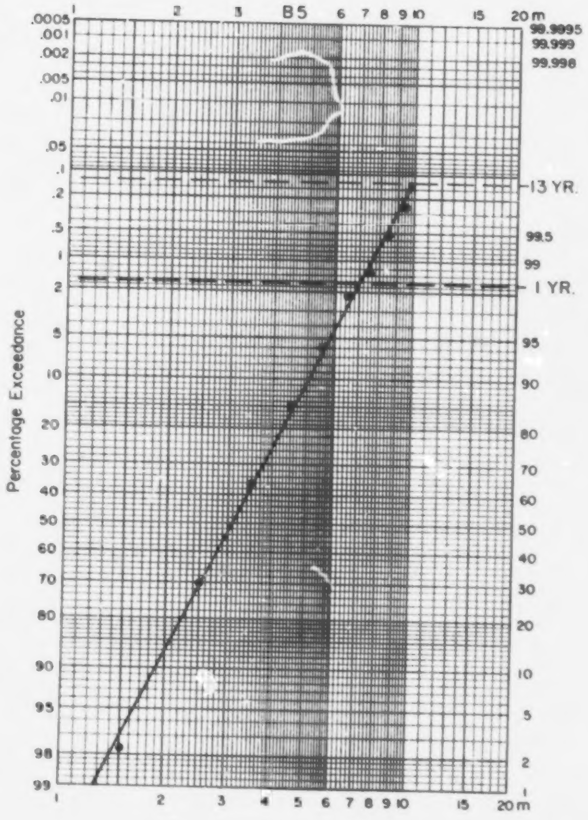
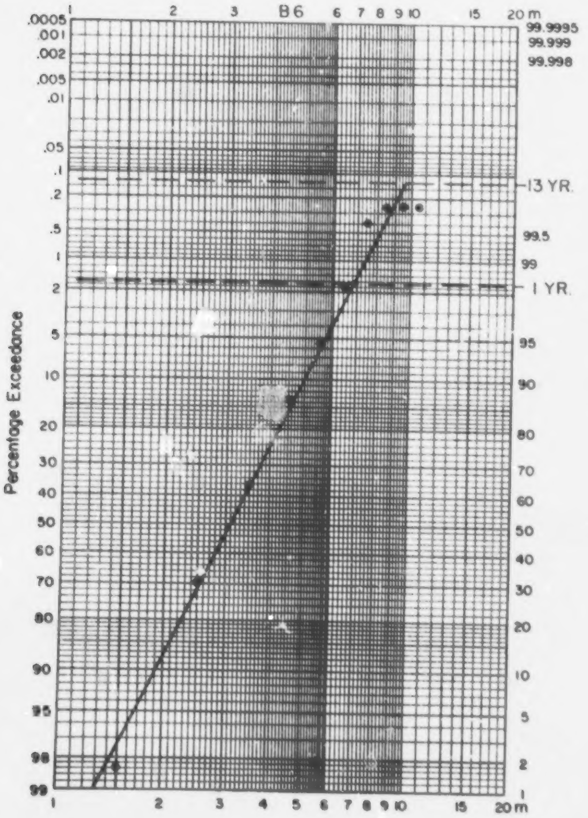


Figure 4e. Monthly Wave Height Exceedance Distribution for April







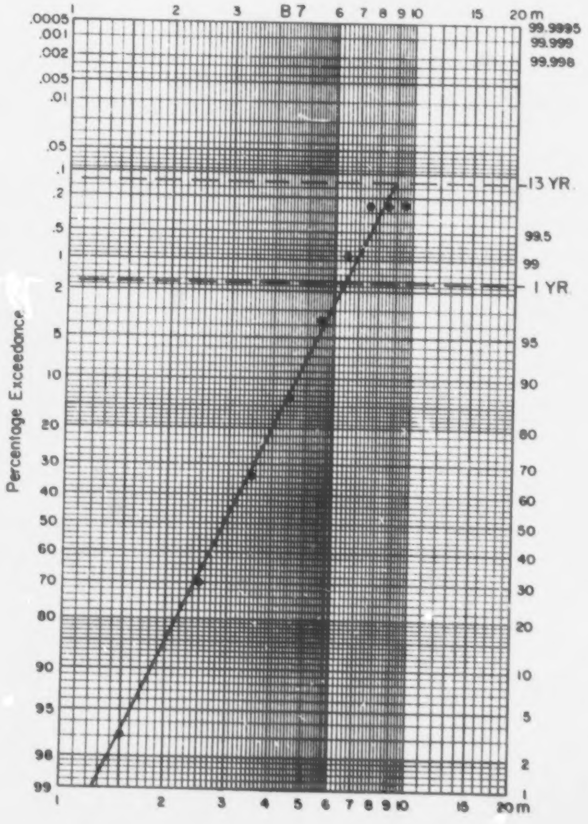


Figure 4f. Monthly Wave Height Exceedance Distribution for April

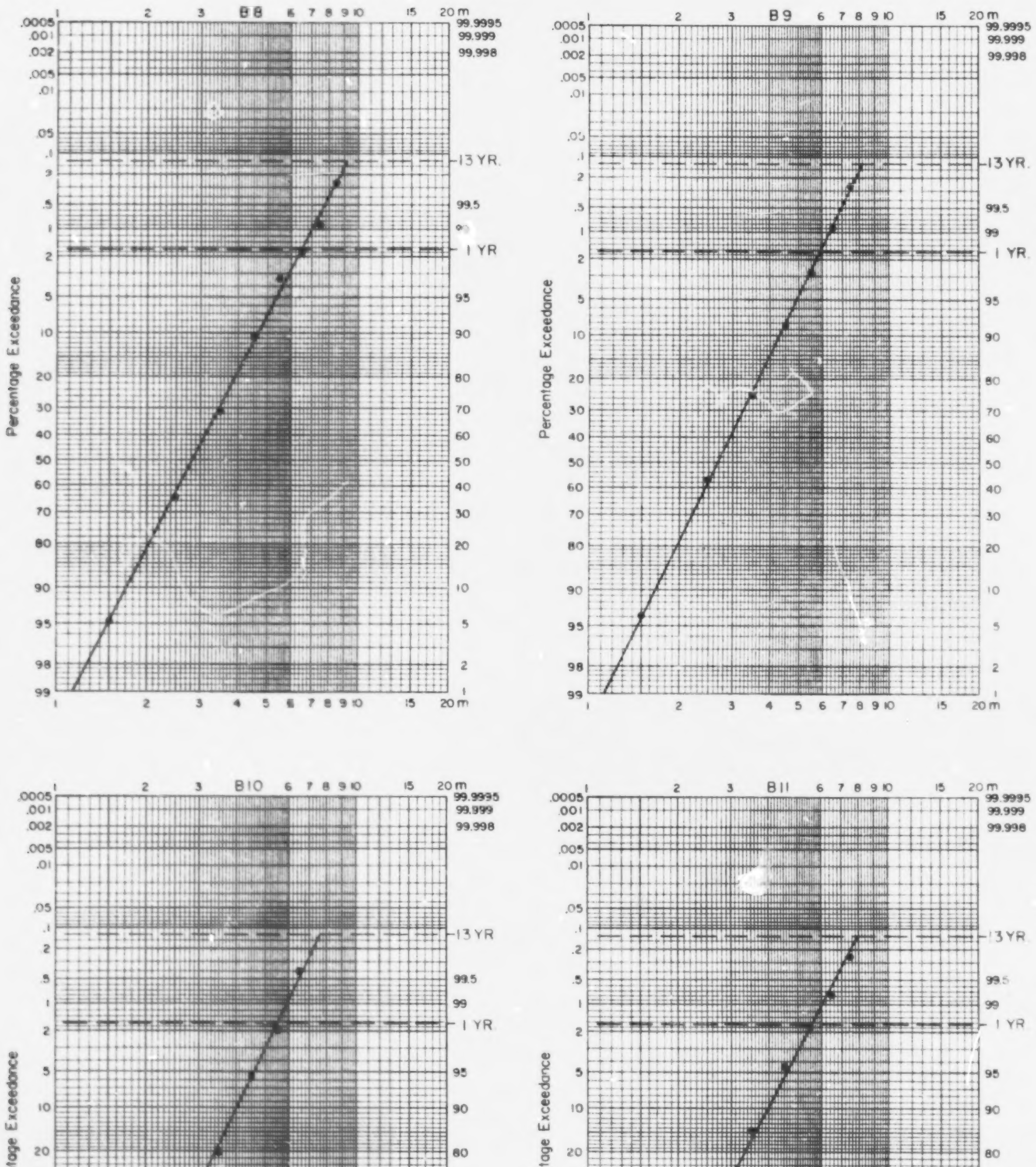
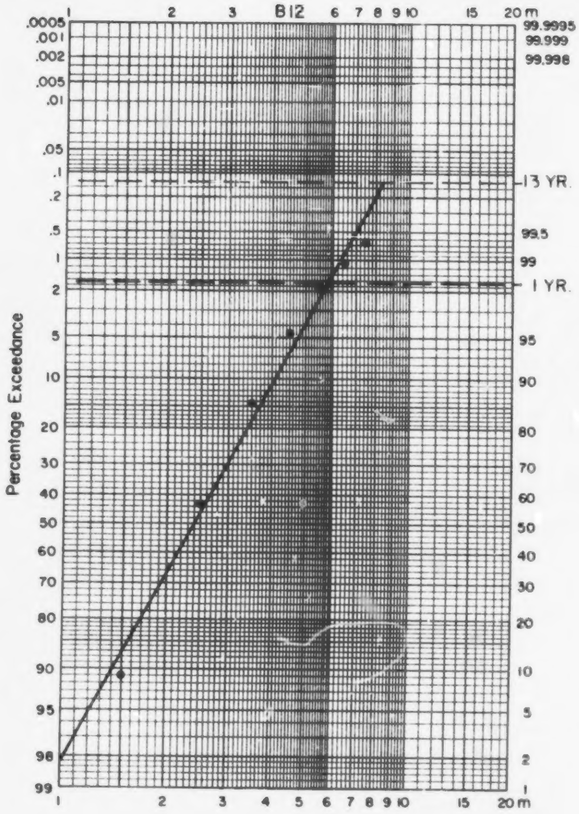
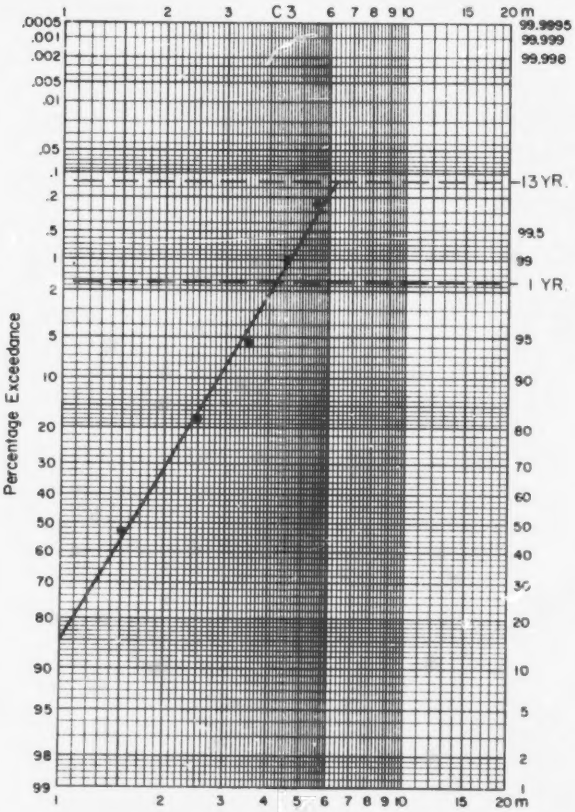
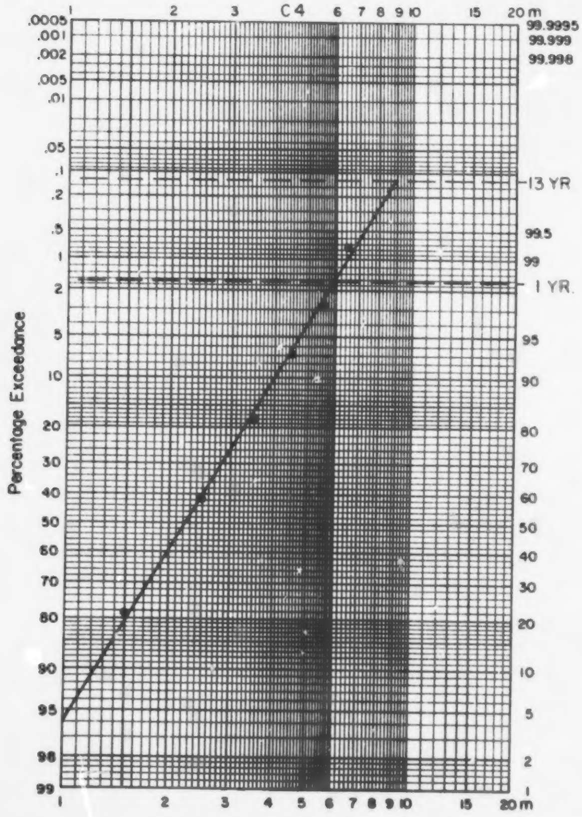


Figure 4g. Monthly Wave Height Exceedance Distribution for April







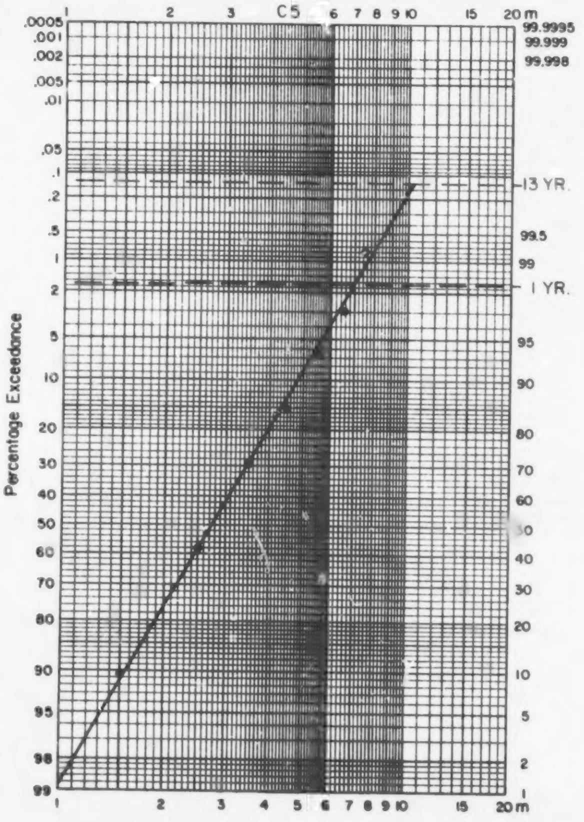


Figure 4h. Monthly Wave Height Exceedance Distribution for April

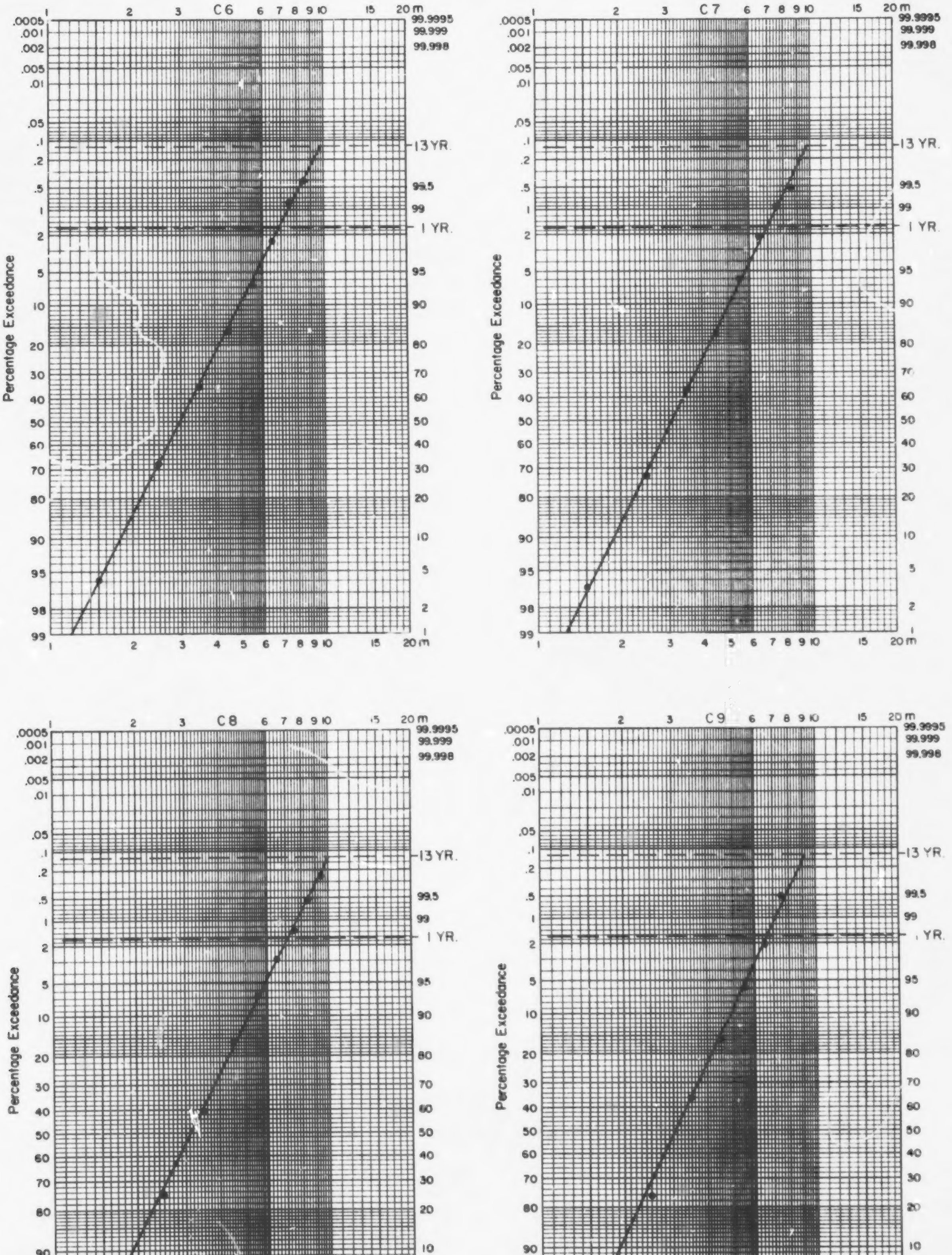


Figure 4i. Monthly Wave Height Exceedance Distribution for April

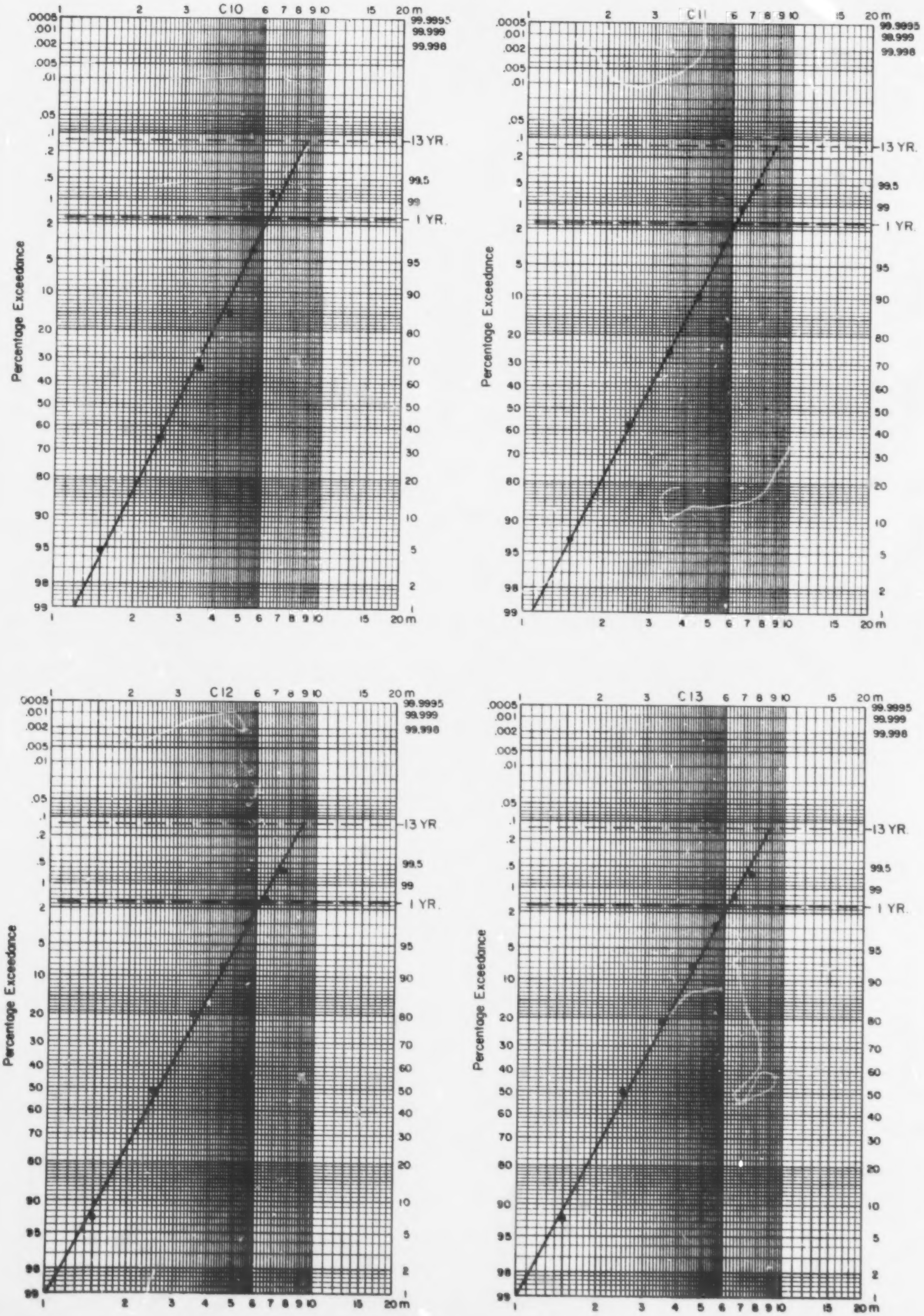


Figure 4j. Monthly Wave Height Exceedance Distribution for April

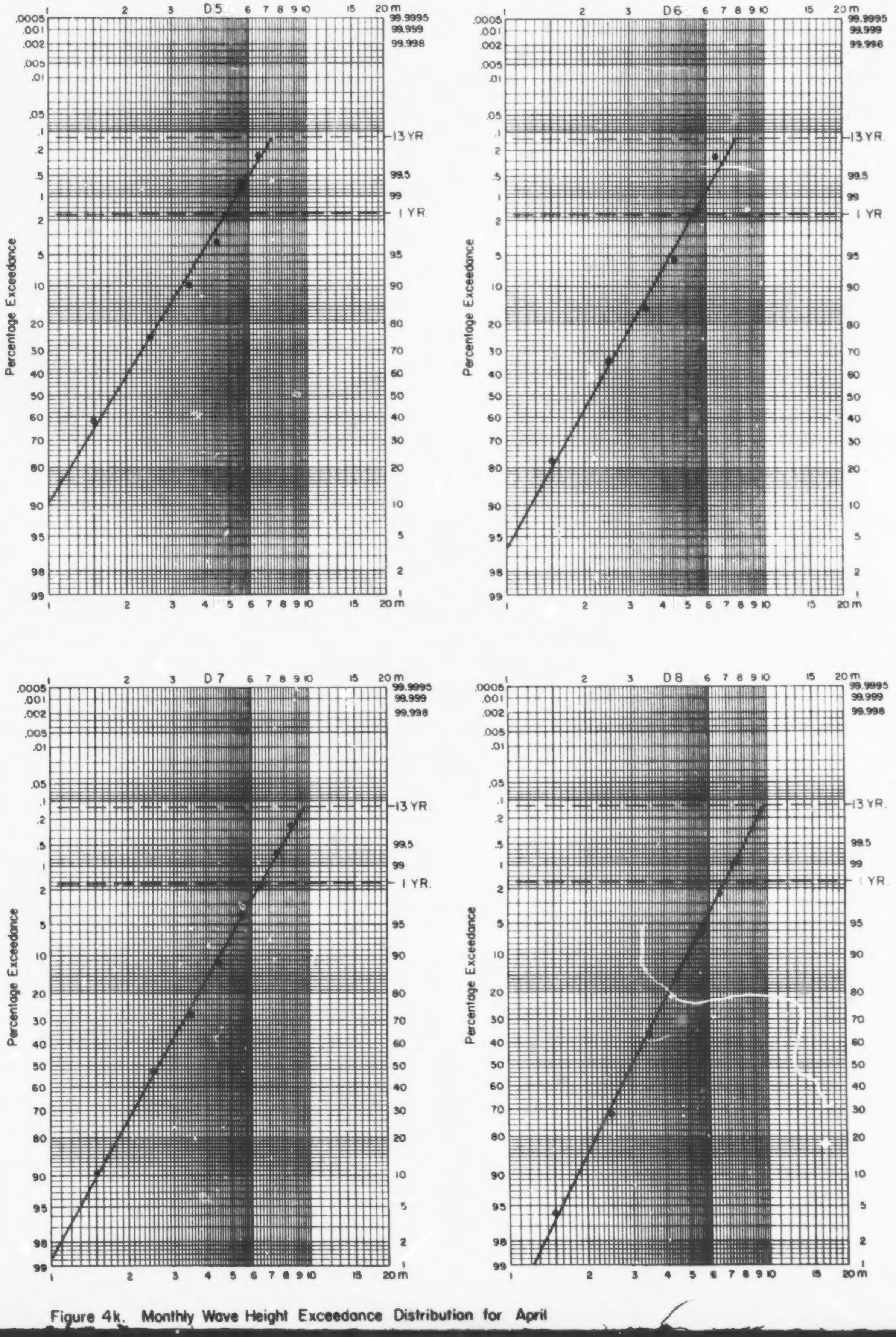


Figure 4k. Monthly Wave Height Exceedance Distribution for April

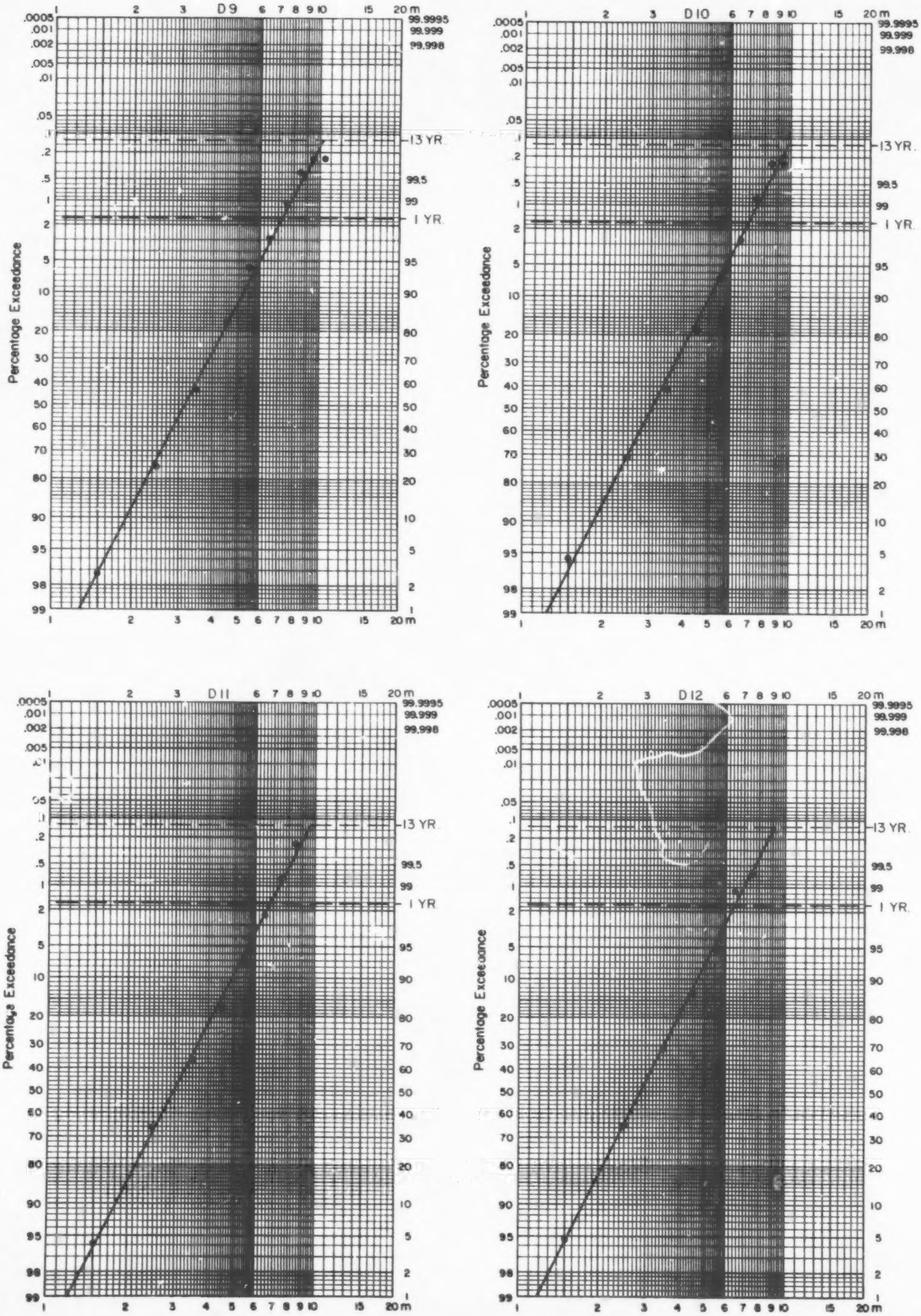


Figure 41. Monthly Wave Height Exceedance Distribution for April

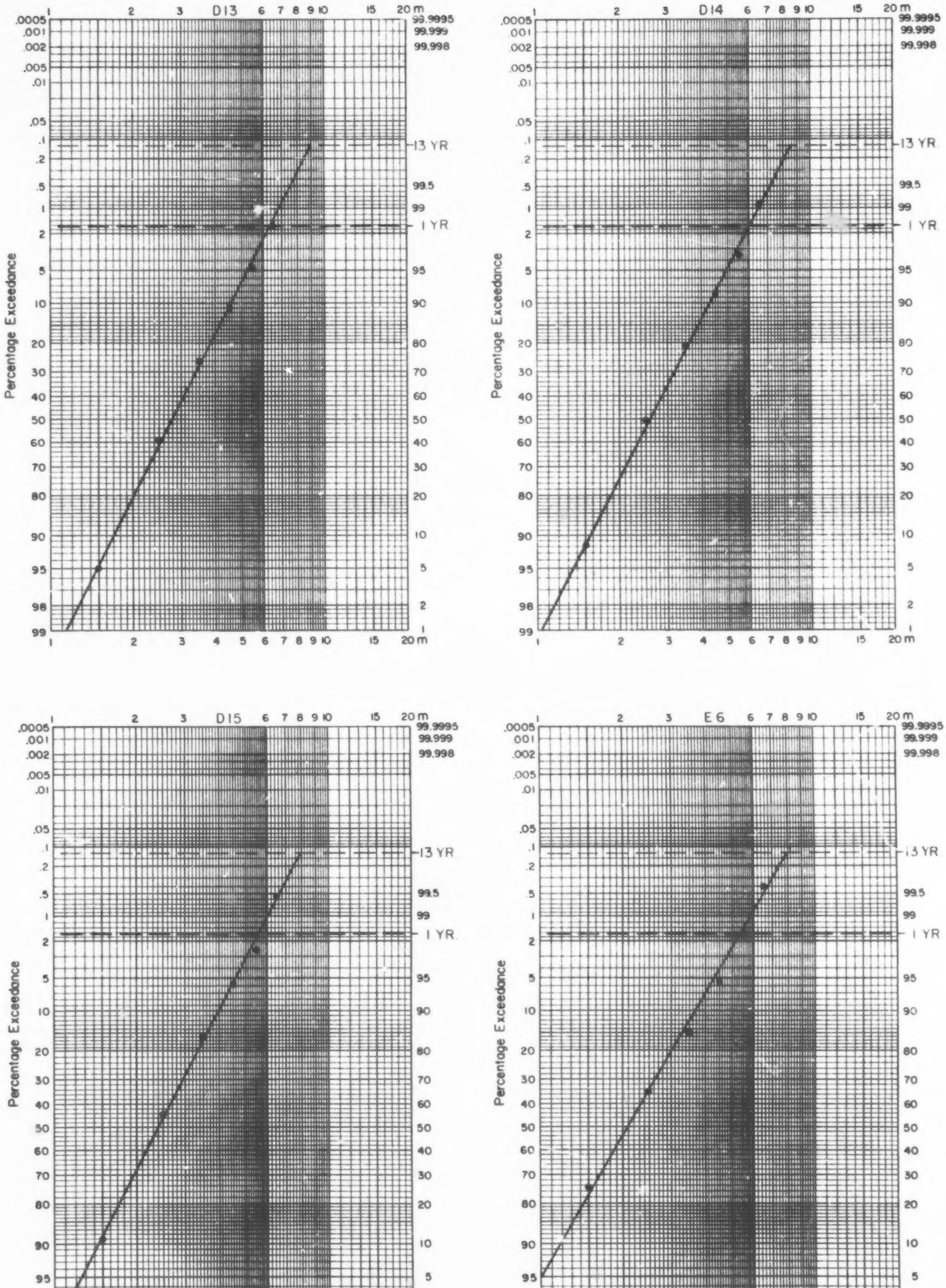


Figure 4m. Monthly Wave Height Exceedance Distribution for April

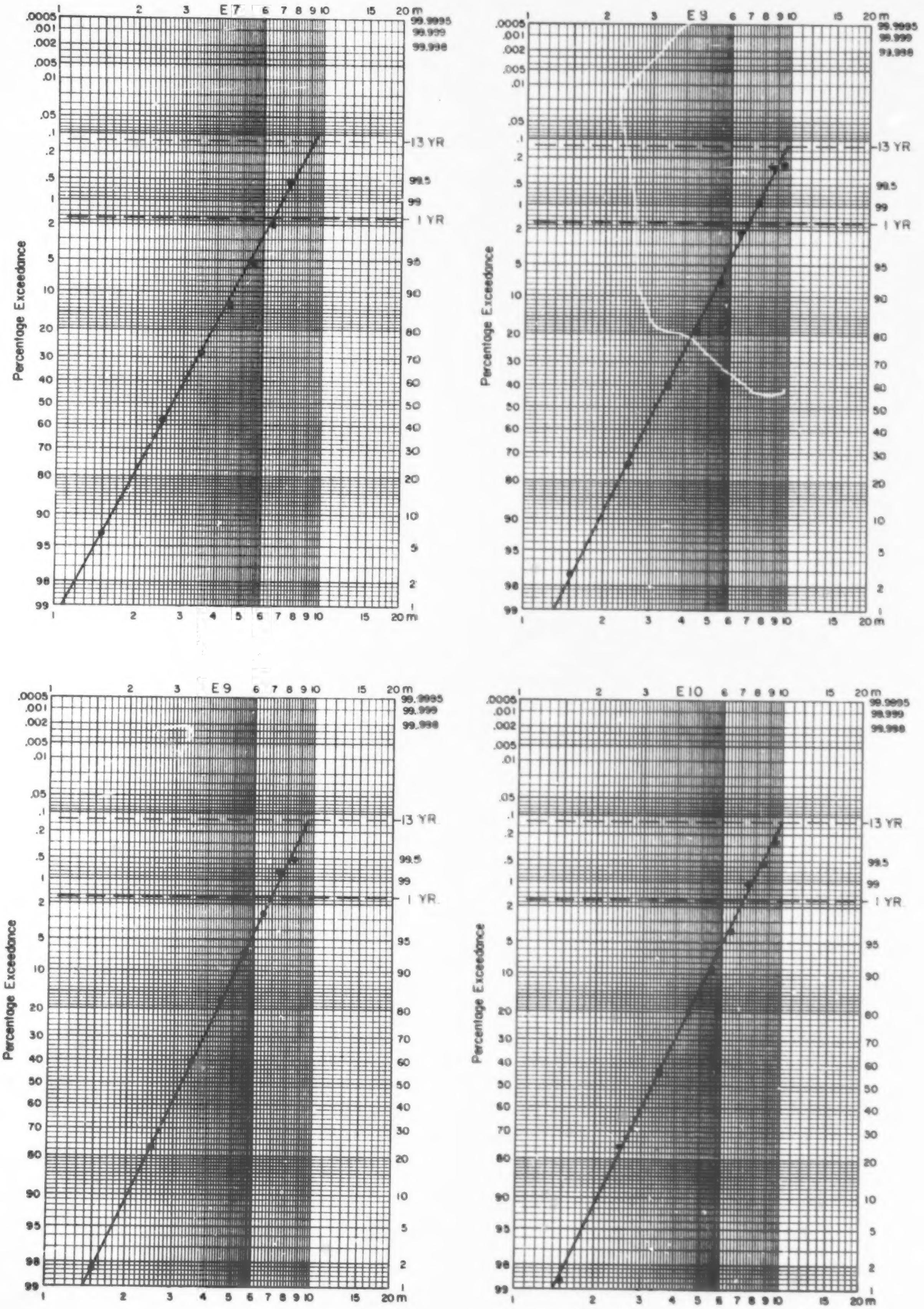
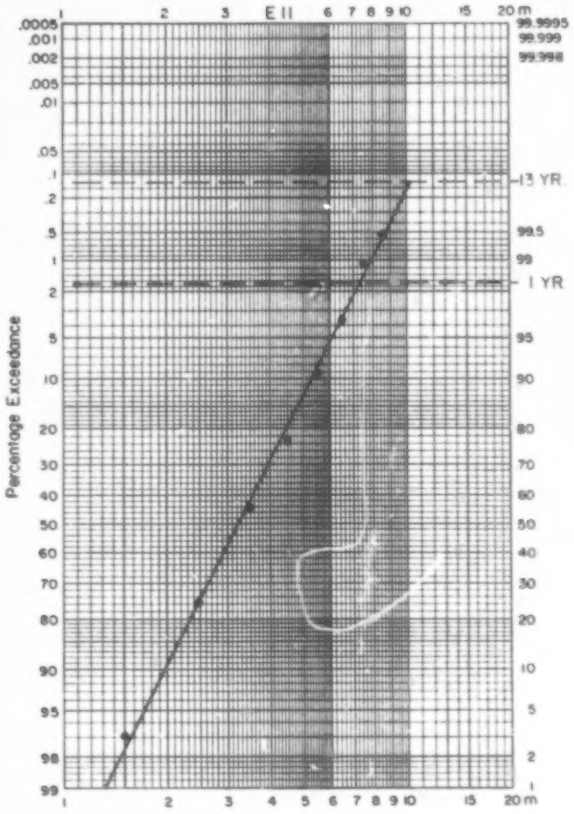
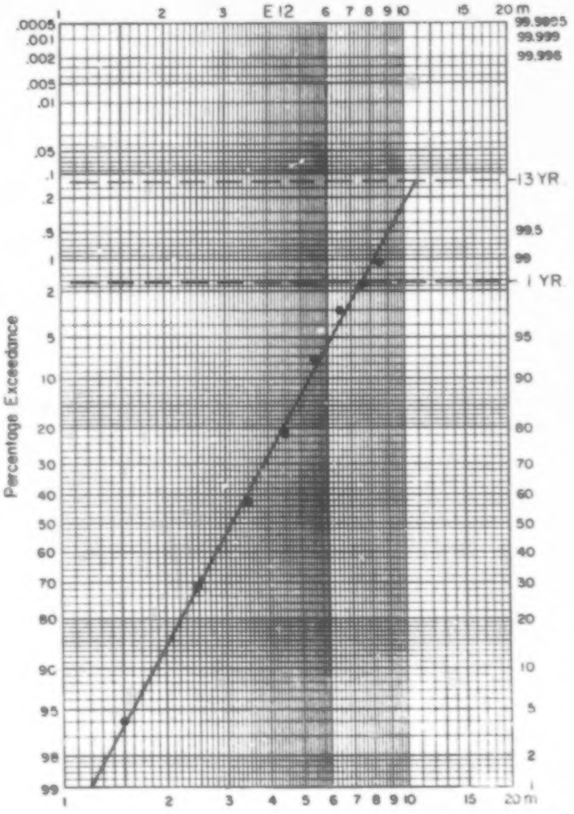
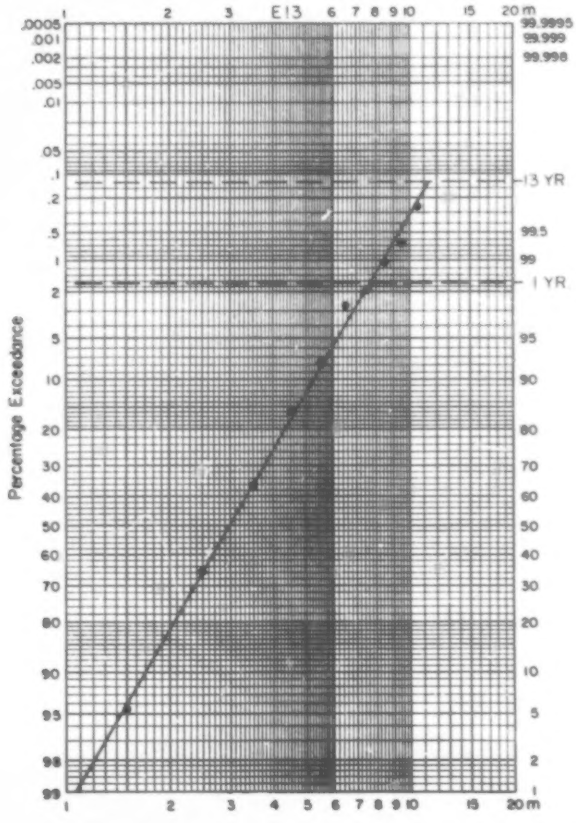


Figure 4n. Monthly Wave Height Exceedance Distribution for April







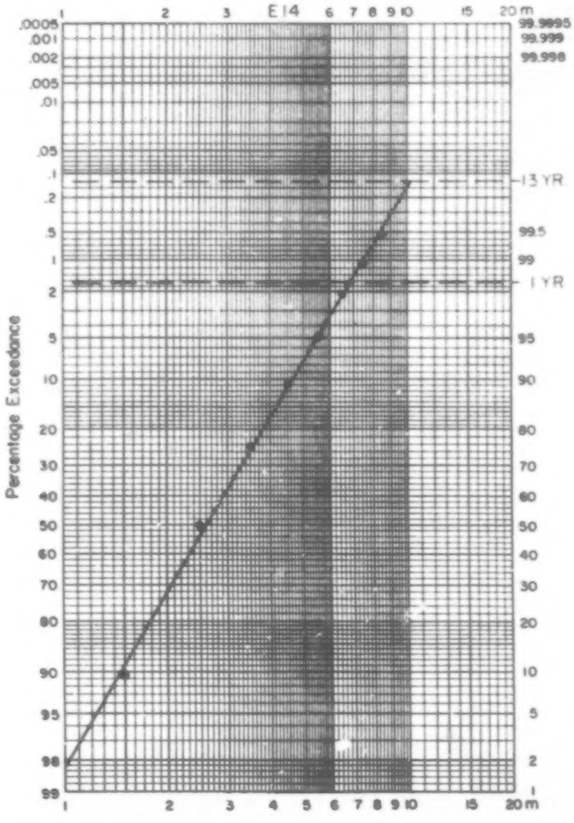


Figure 4 o. Monthly Wave Height Exceedance Distribution for April

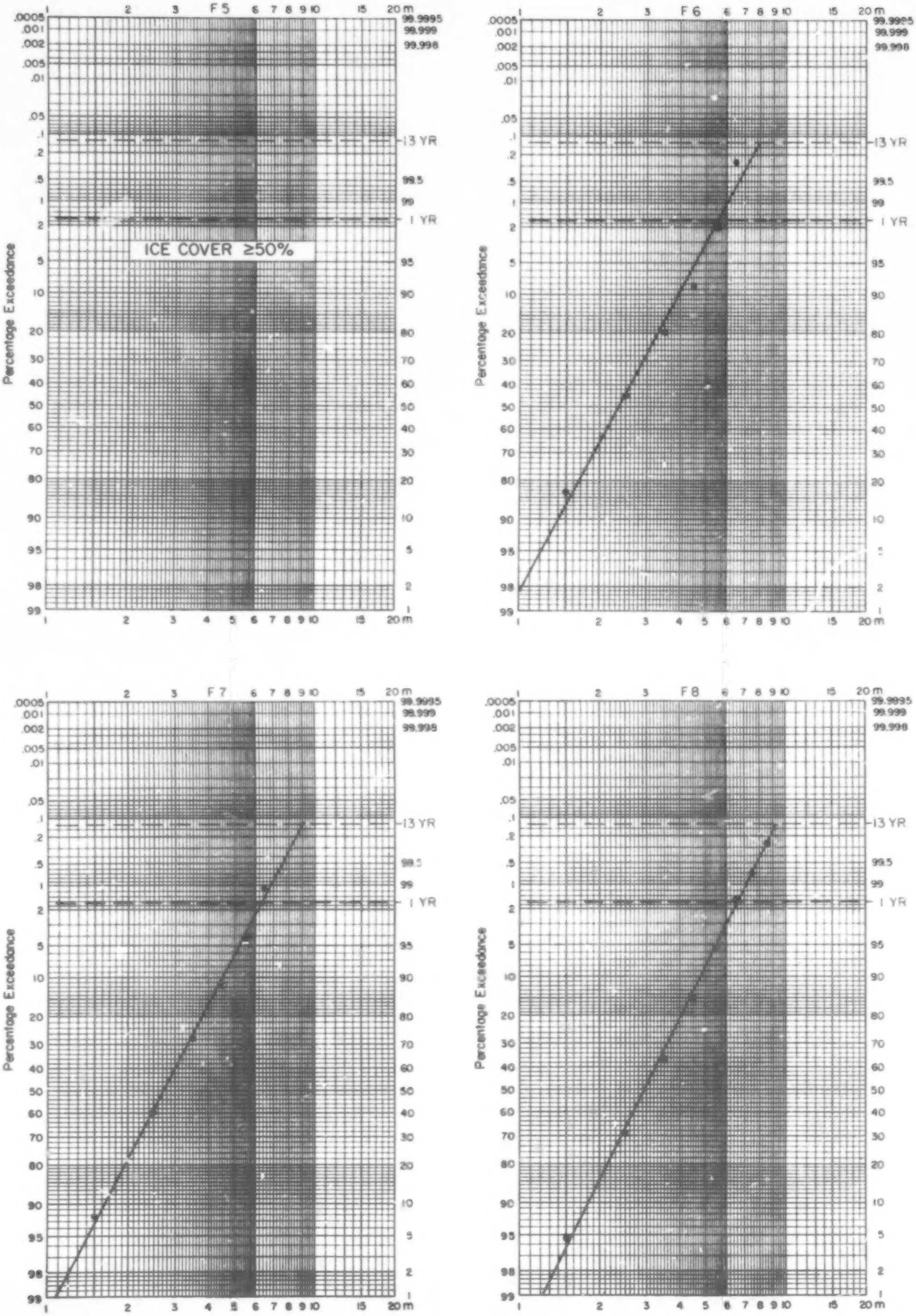


Figure 4p. Monthly wave Height Exceedance Distribution for April

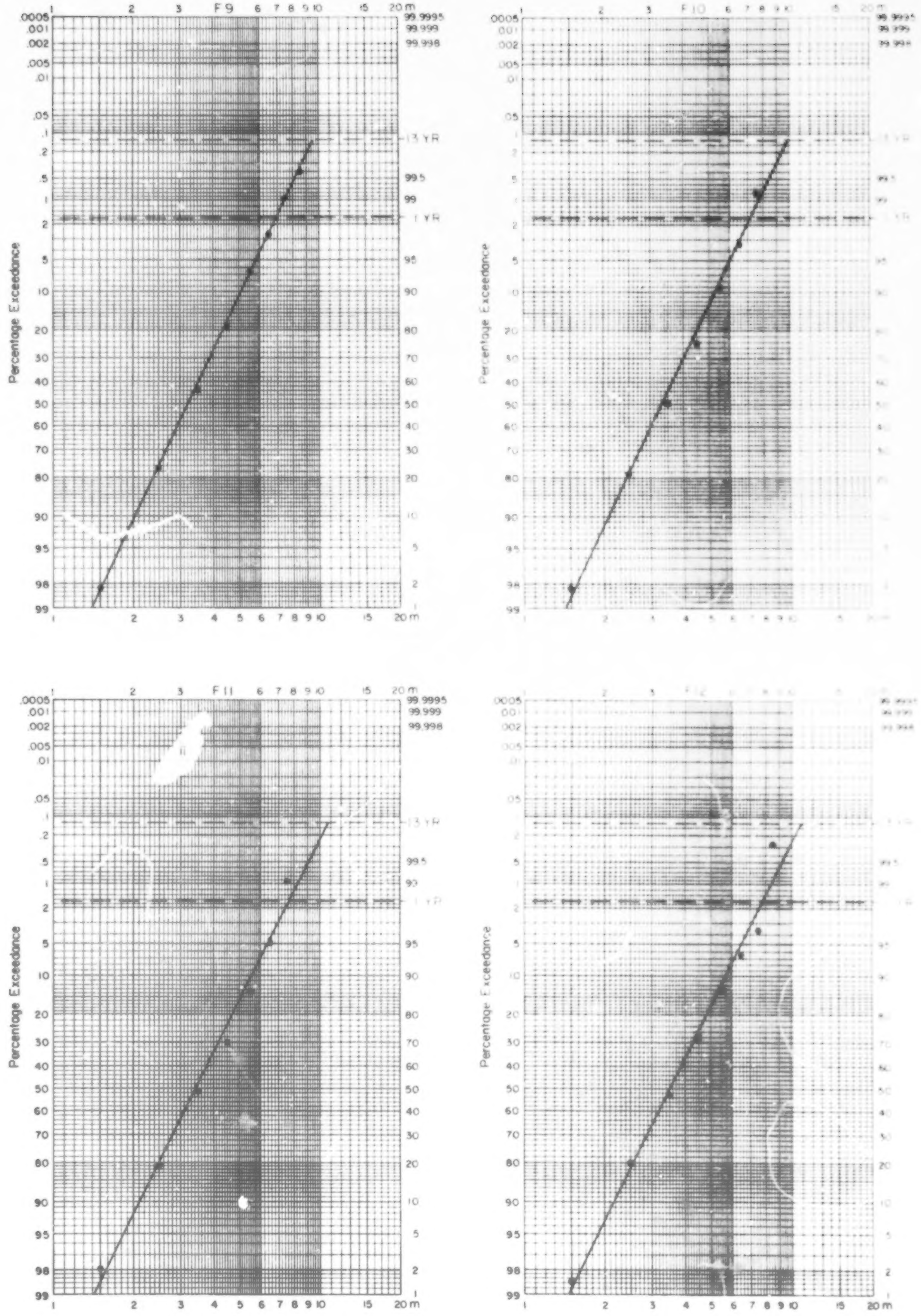


Figure 4q. Monthly Wave Height Exceedance Distribution for April

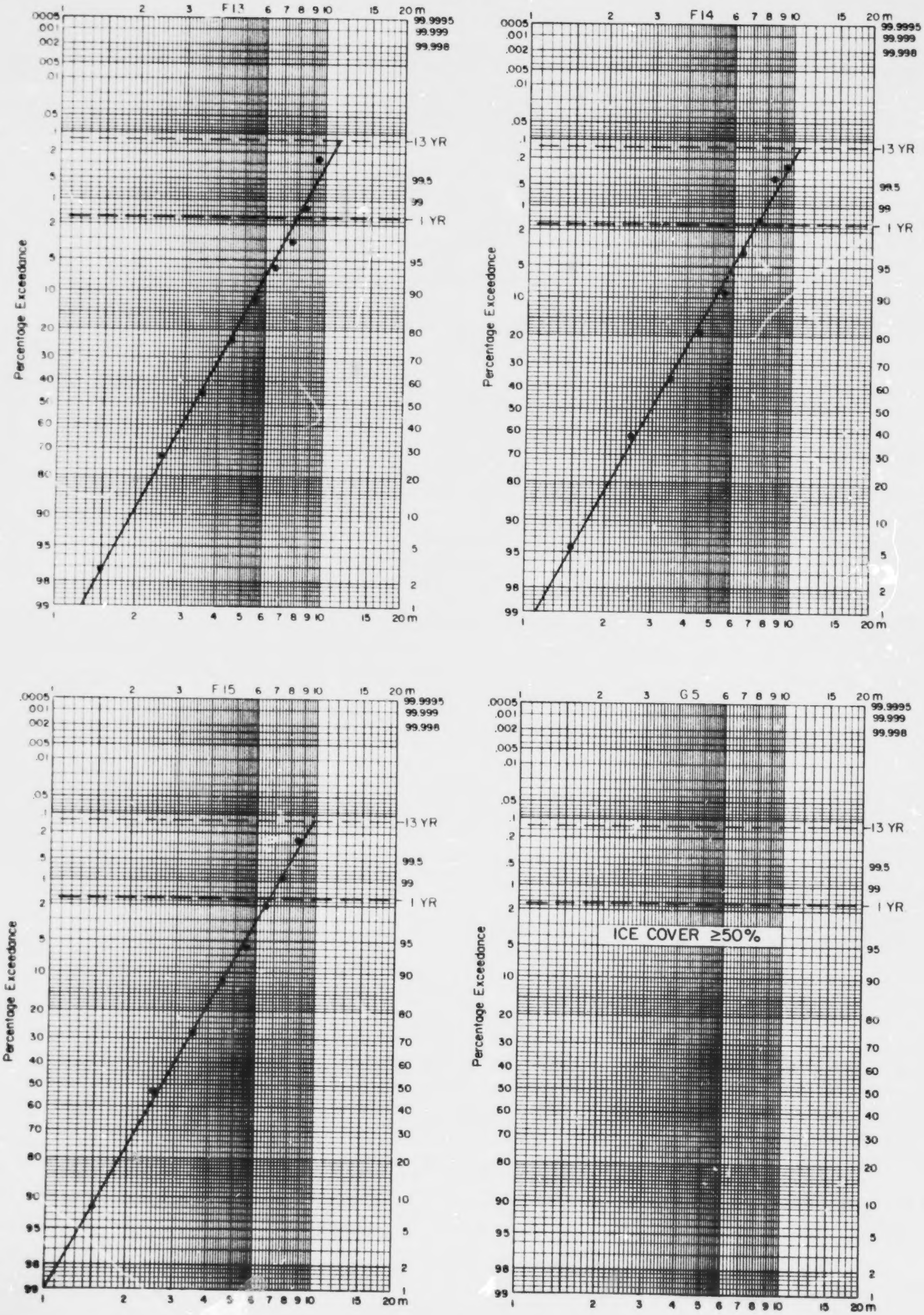


Figure 4r. Monthly Wave Height Exceedance Distribution for April

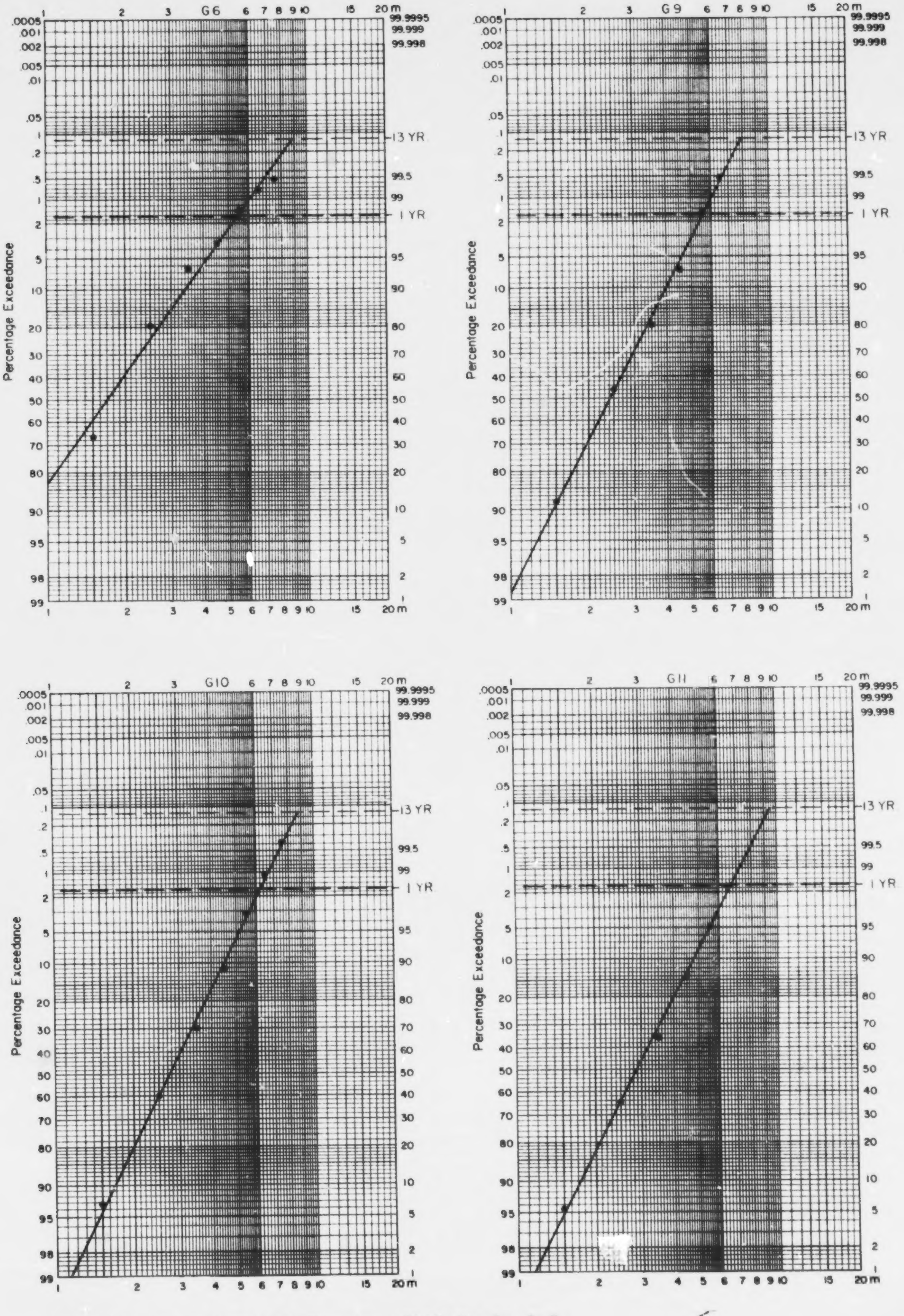


Figure 4s. Monthly Wave Height Exceedance Distribution for April

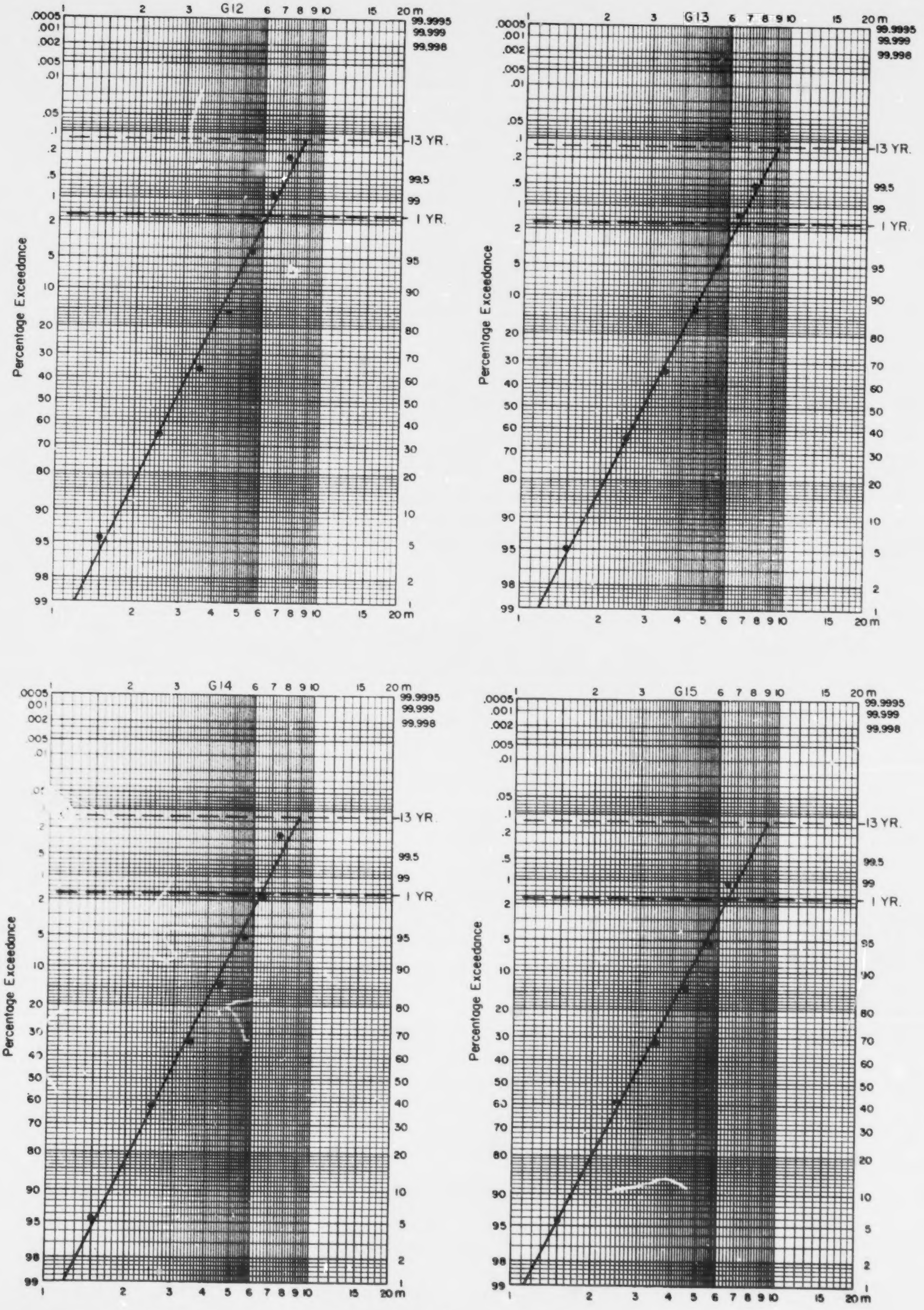
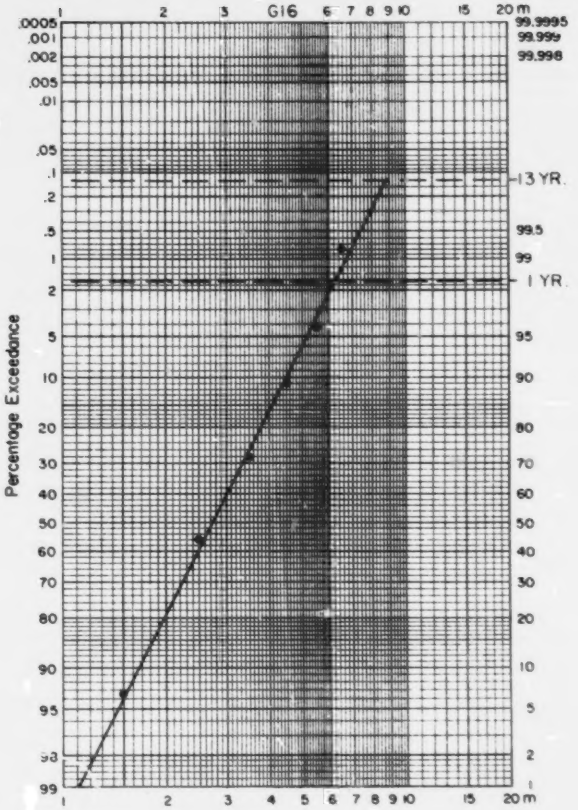
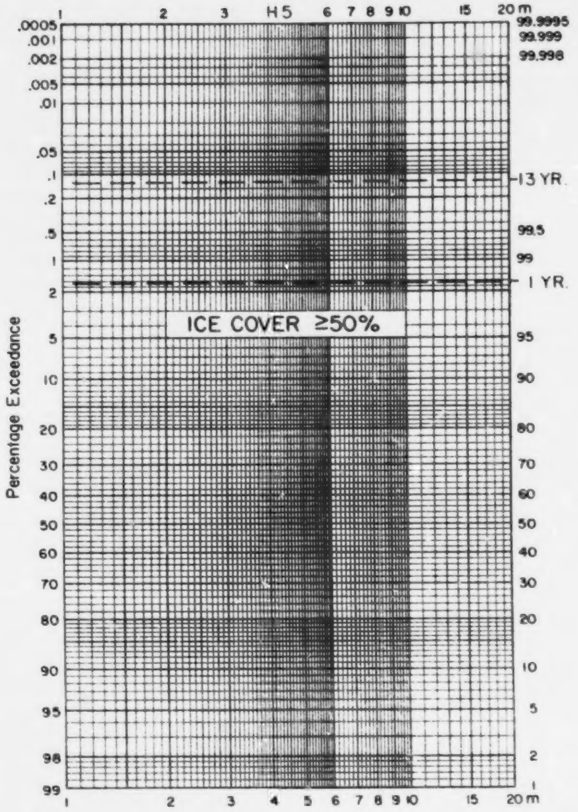
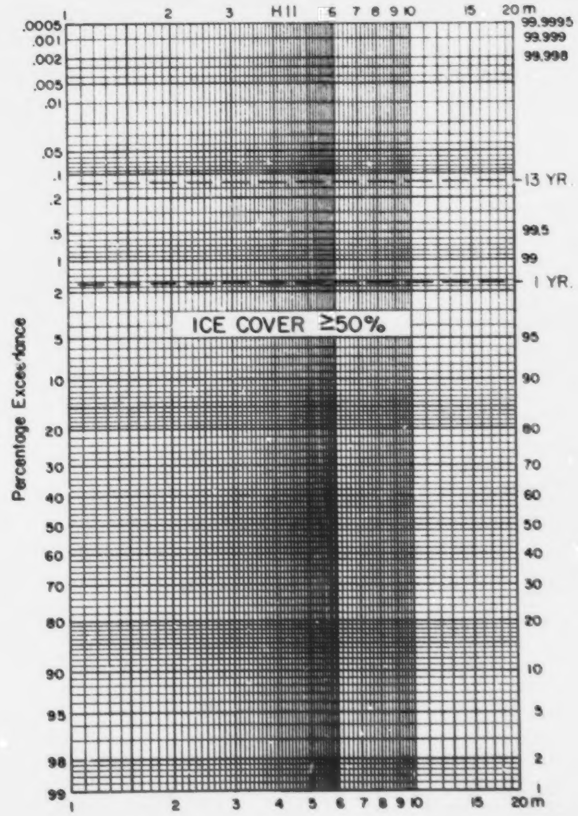


Figure 41. Monthly Wave Height Exceedance Distribution for April







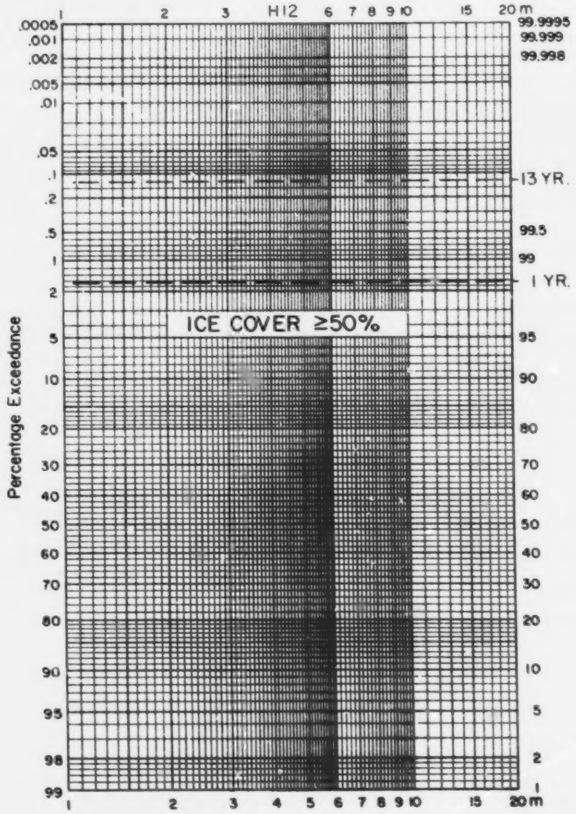
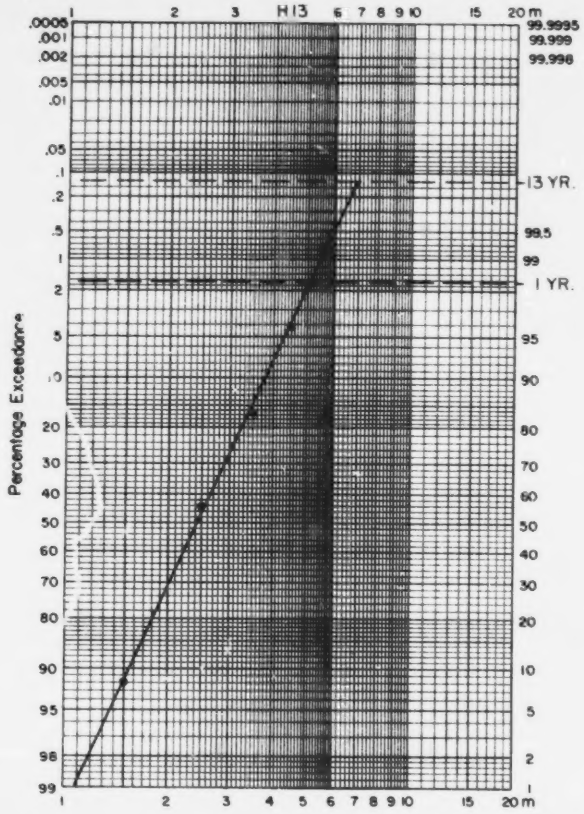
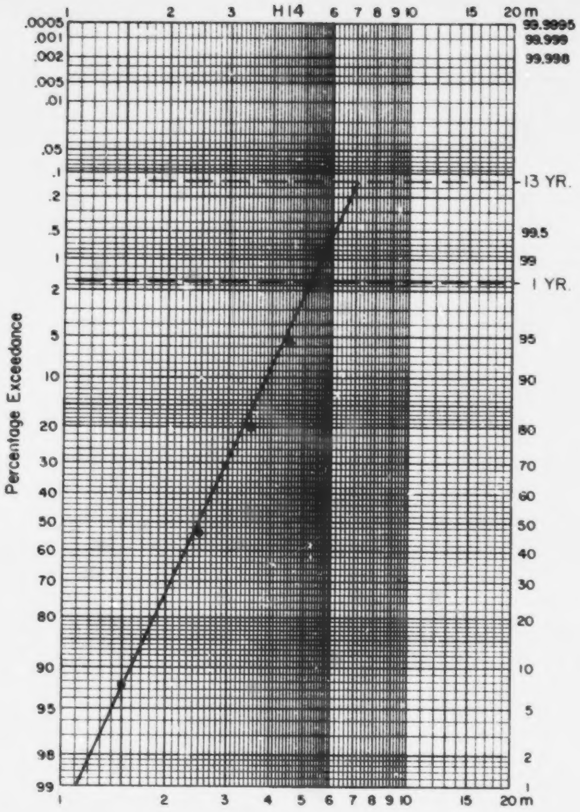
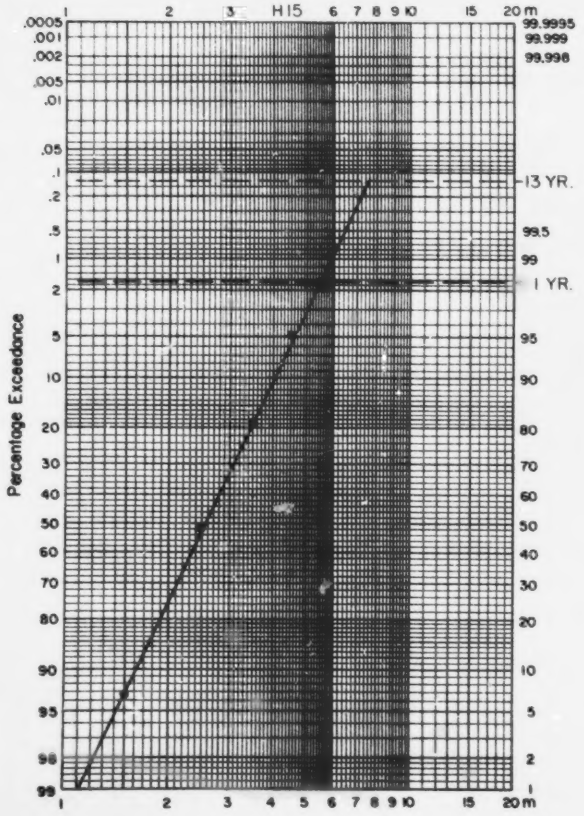


Figure 4u. Monthly Wave Height Exceedance Distribution for April







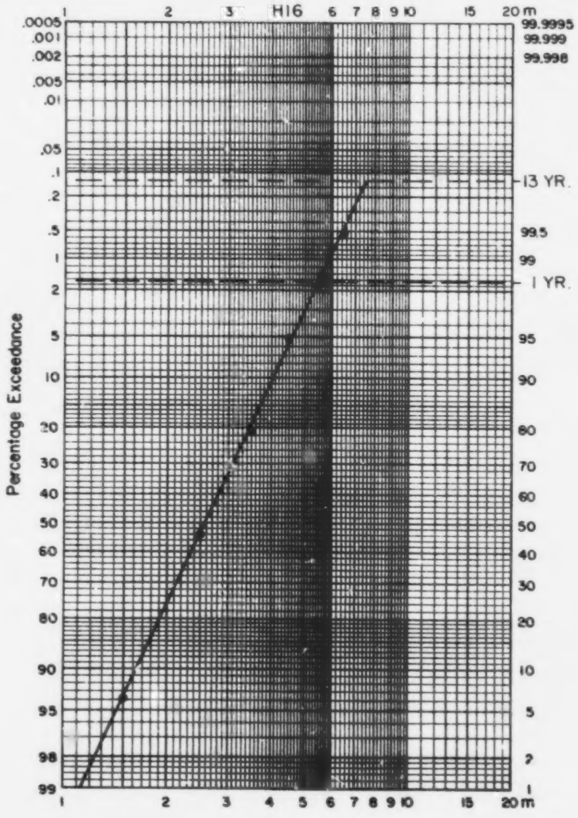


Figure 4v. Monthly Wave Height Exceedance Distribution for April

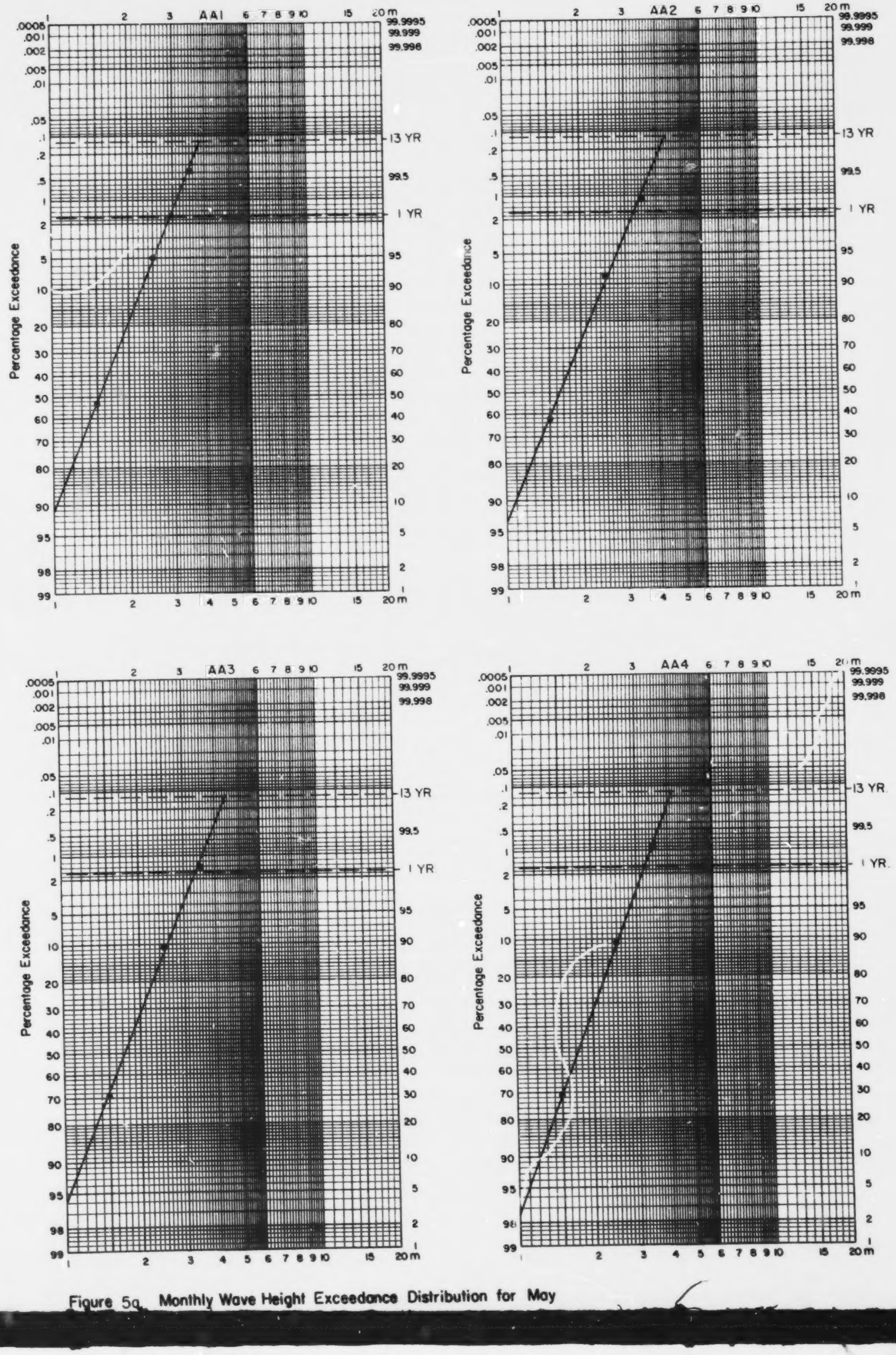


Figure 5a. Monthly Wave Height Exceedance Distribution for May

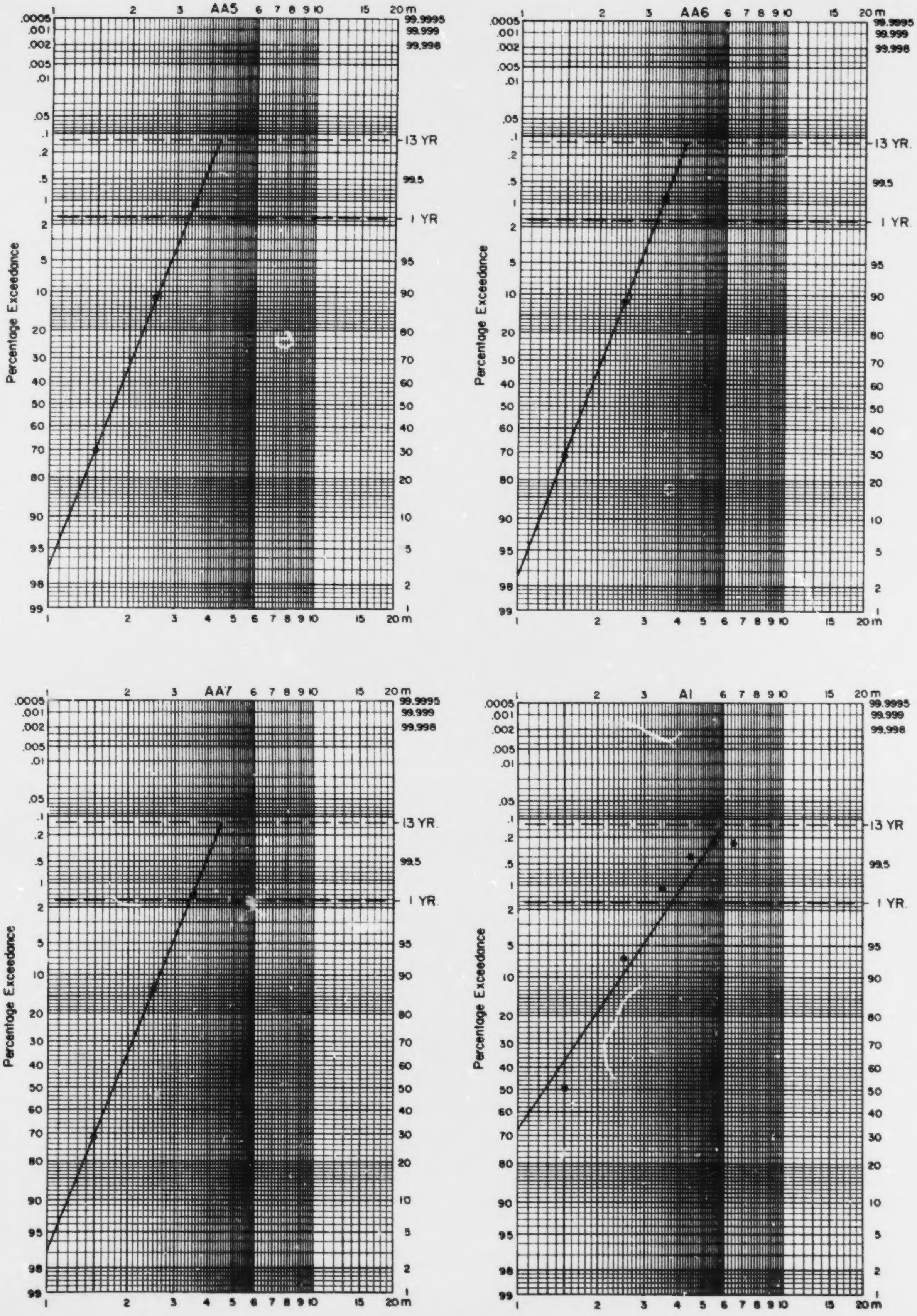


Figure 5b. Monthly Wave Height Exceedance Distribution for May

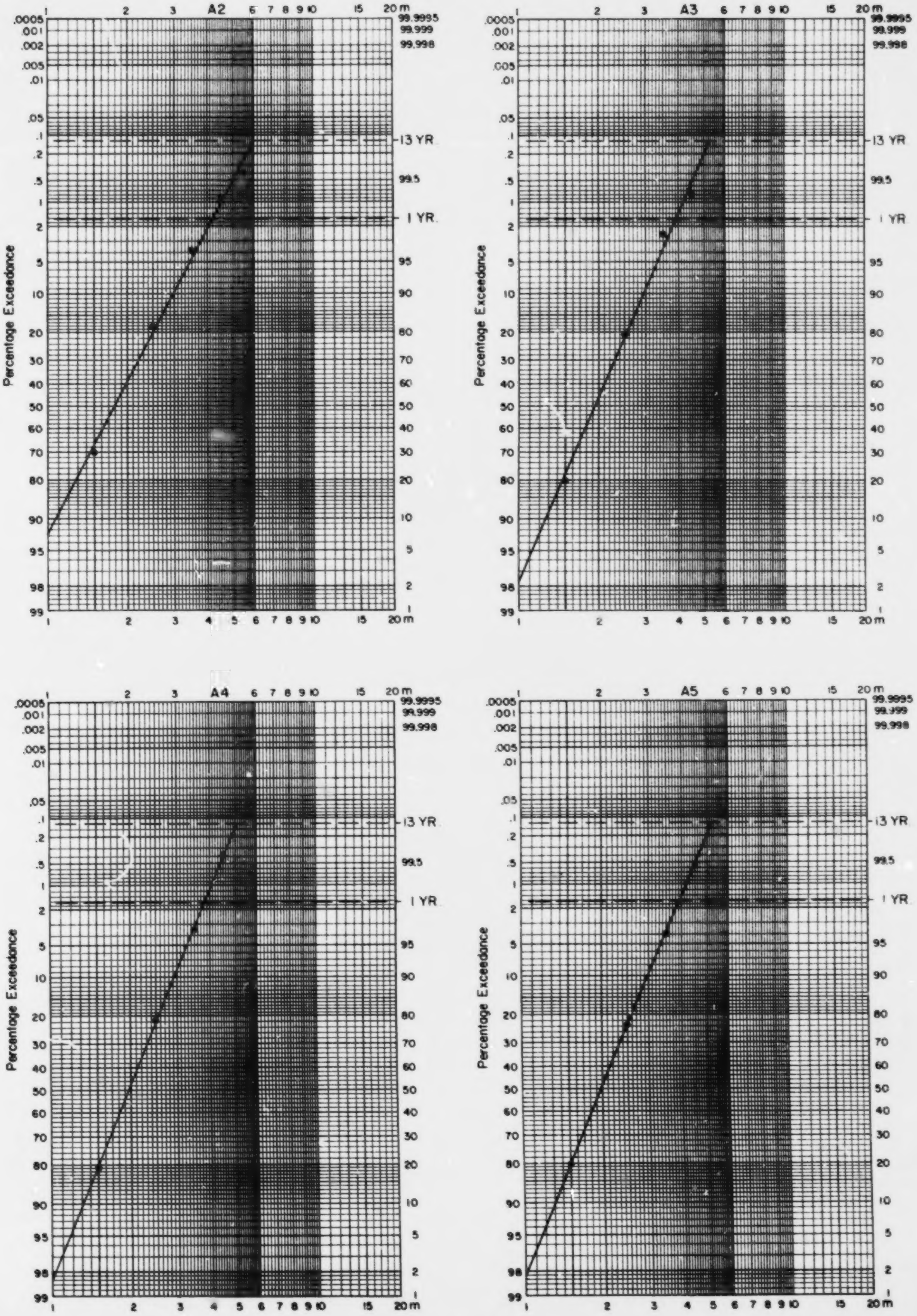


Figure 5c. Monthly Wave Height Exceedance Distribution for May

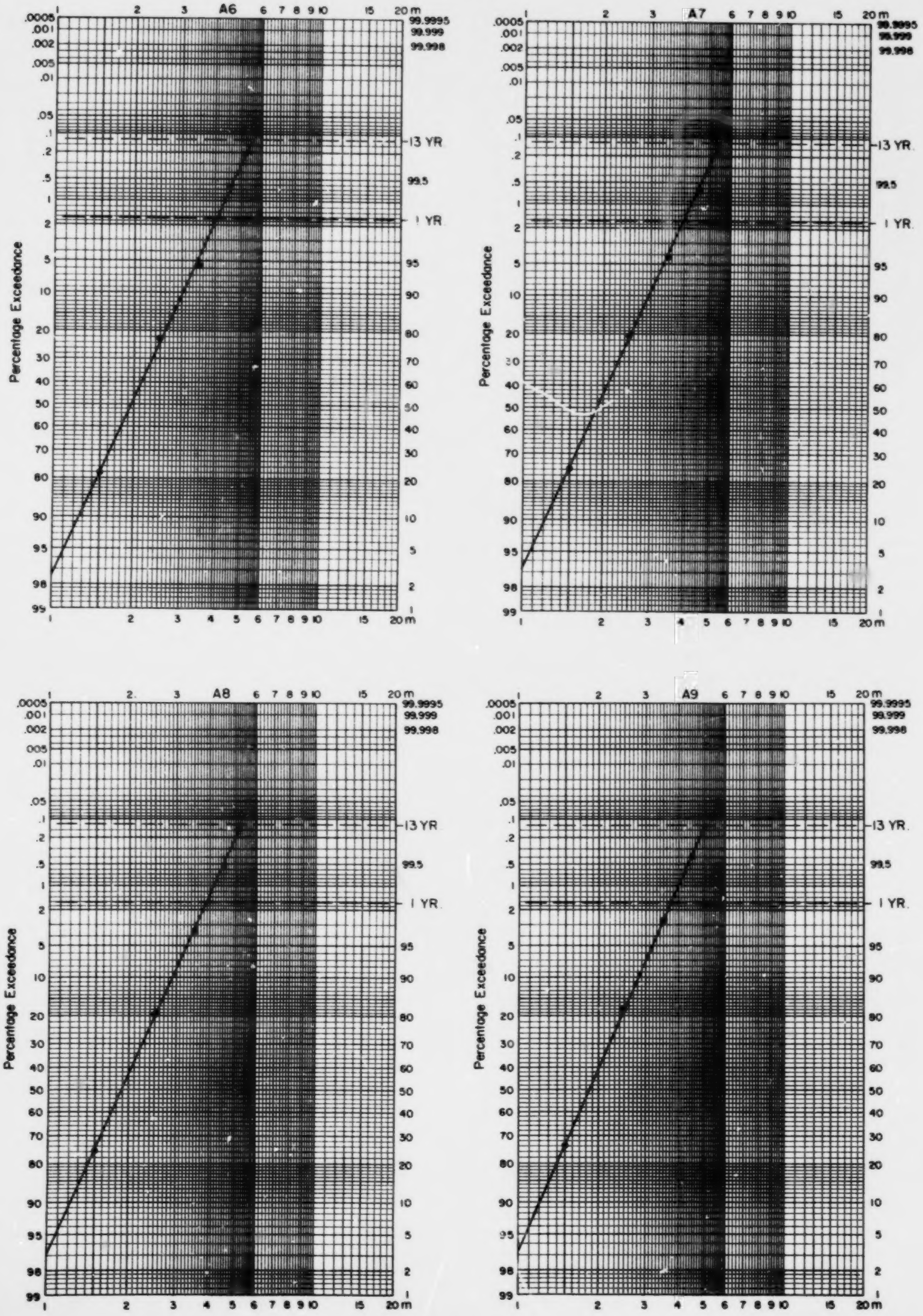
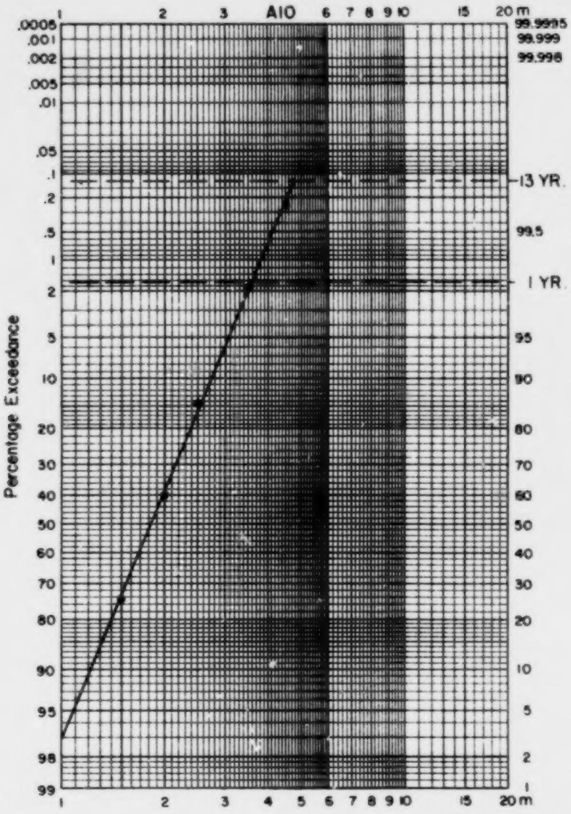
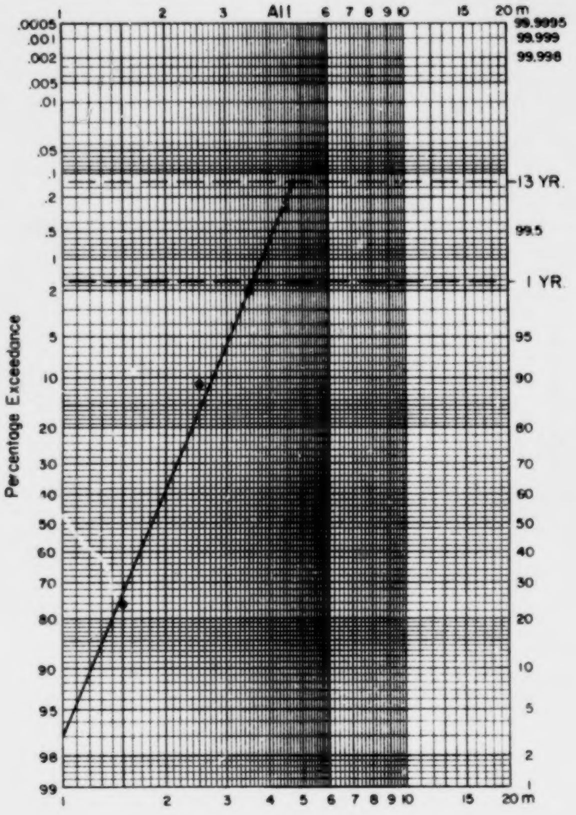
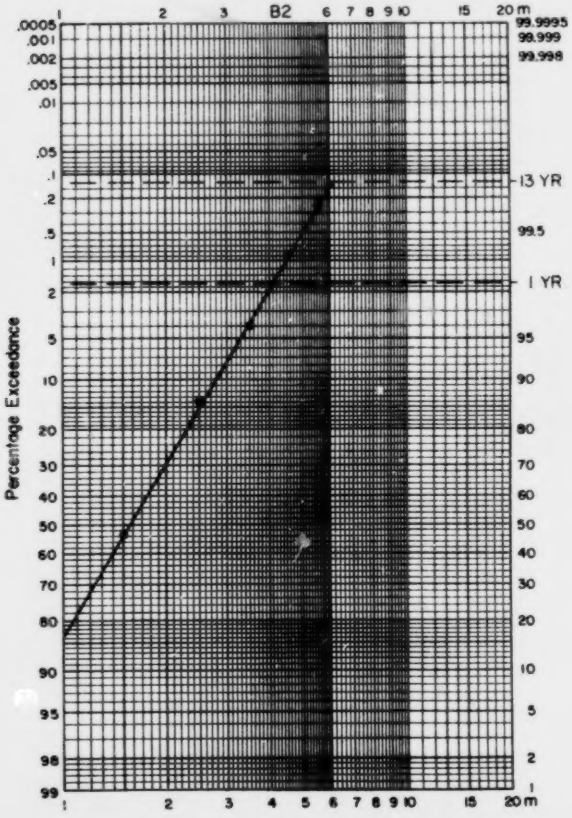


Figure 5d. Monthly Wave Height Exceedance Distribution for May







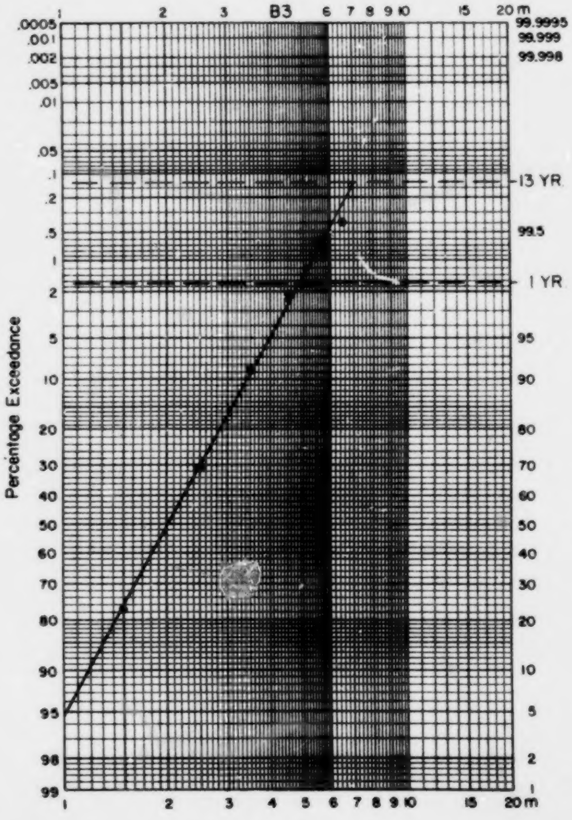


Figure 5e. Monthly Wave Height Exceedance Distribution for May

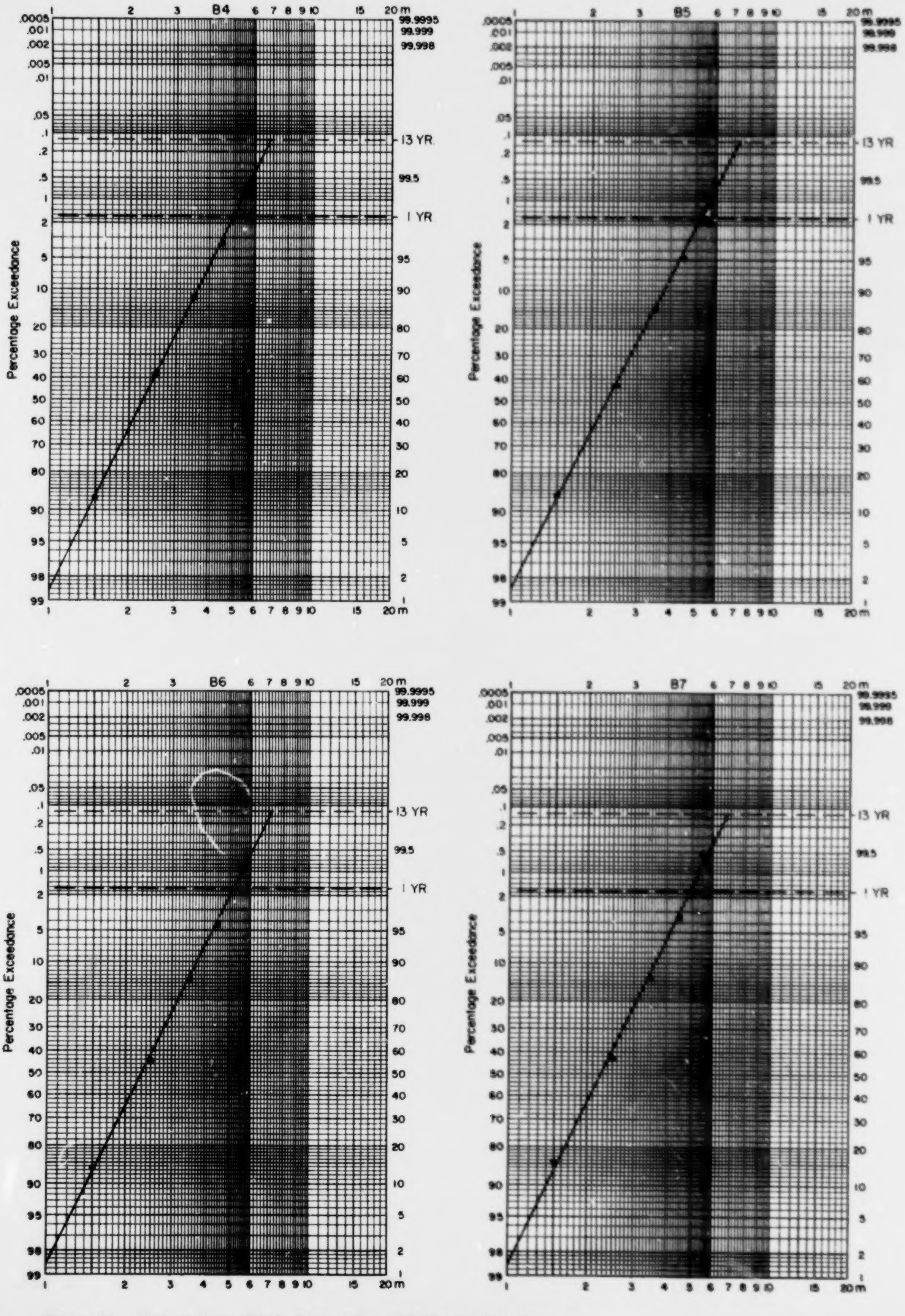


Figure 5f. Monthly Wave Height Exceedance Distribution for May

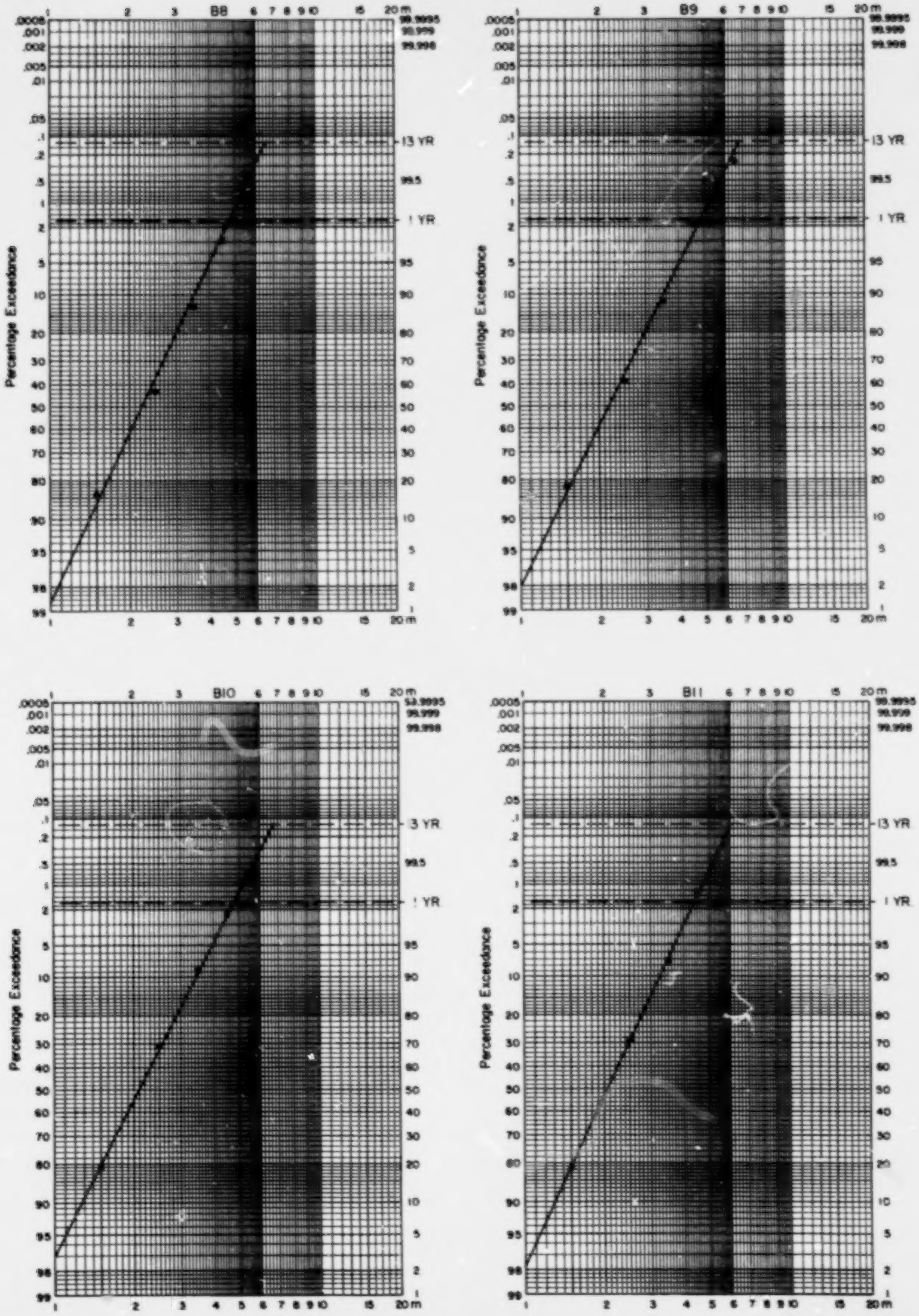


Figure 5g. Monthly Wave Height Exceedance Distribution for May

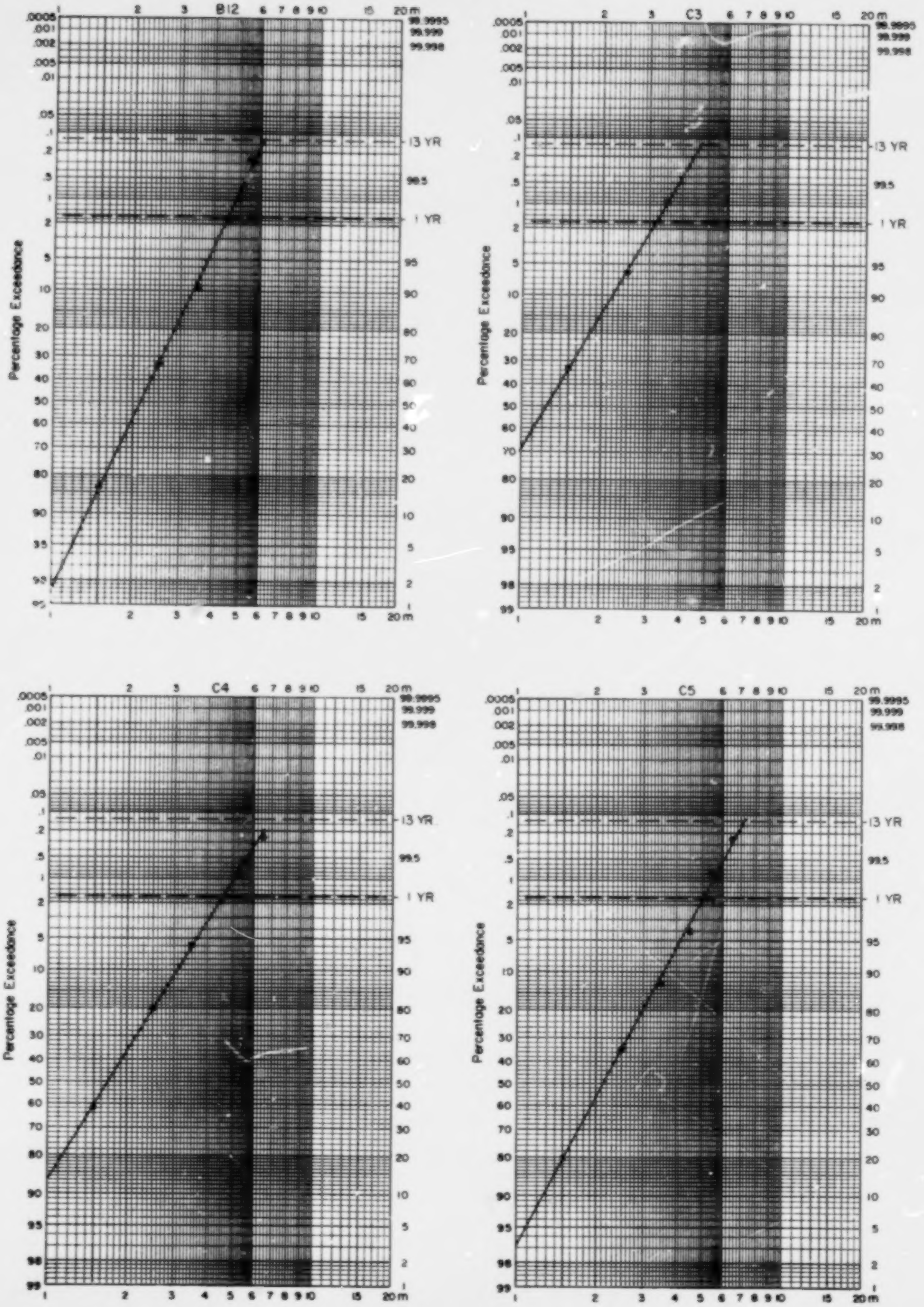


Figure 5h. Monthly Wave Height Exceedance Distribution for May

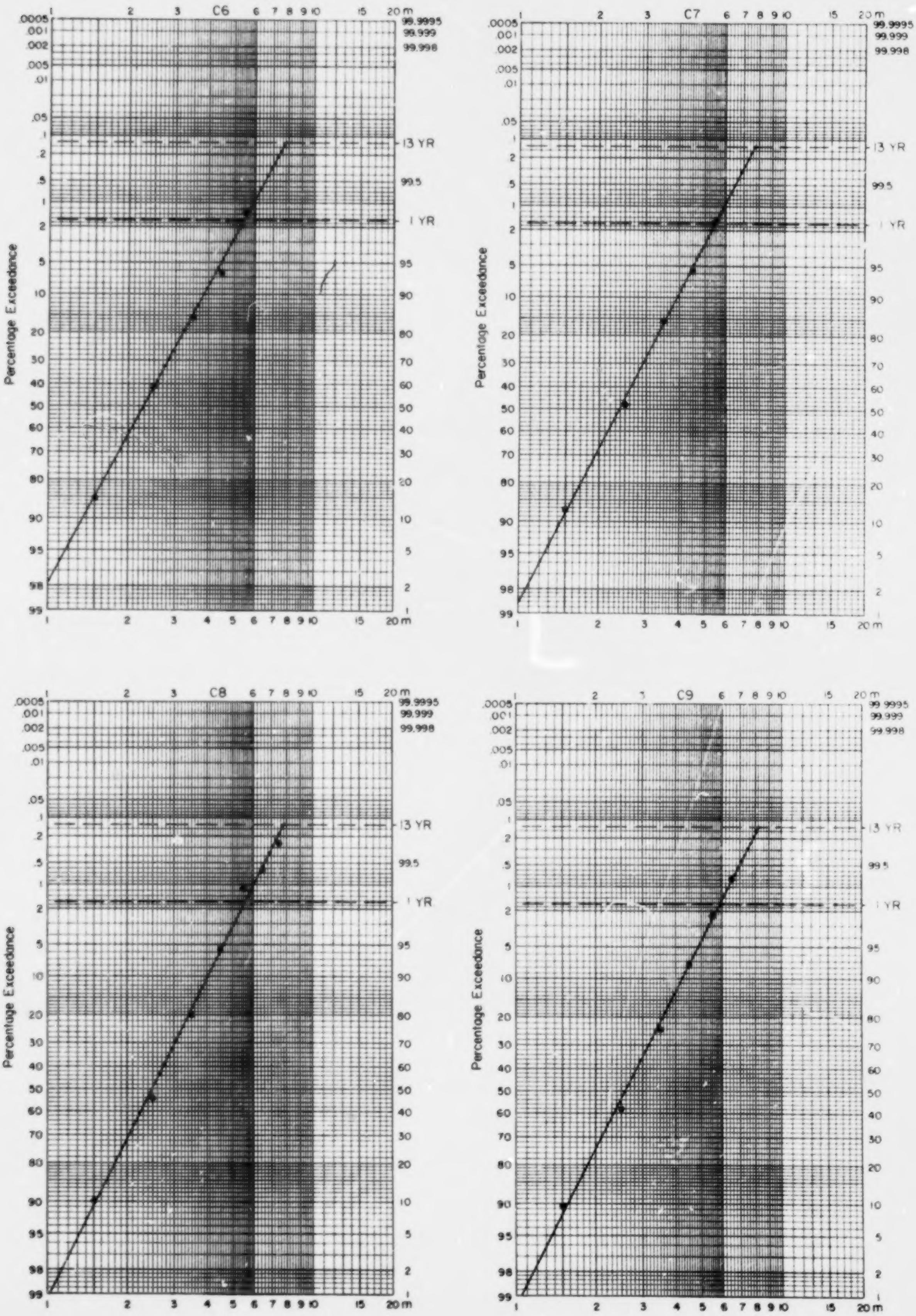


Figure 5i. Monthly Wave Height Exceedance Distribution for May

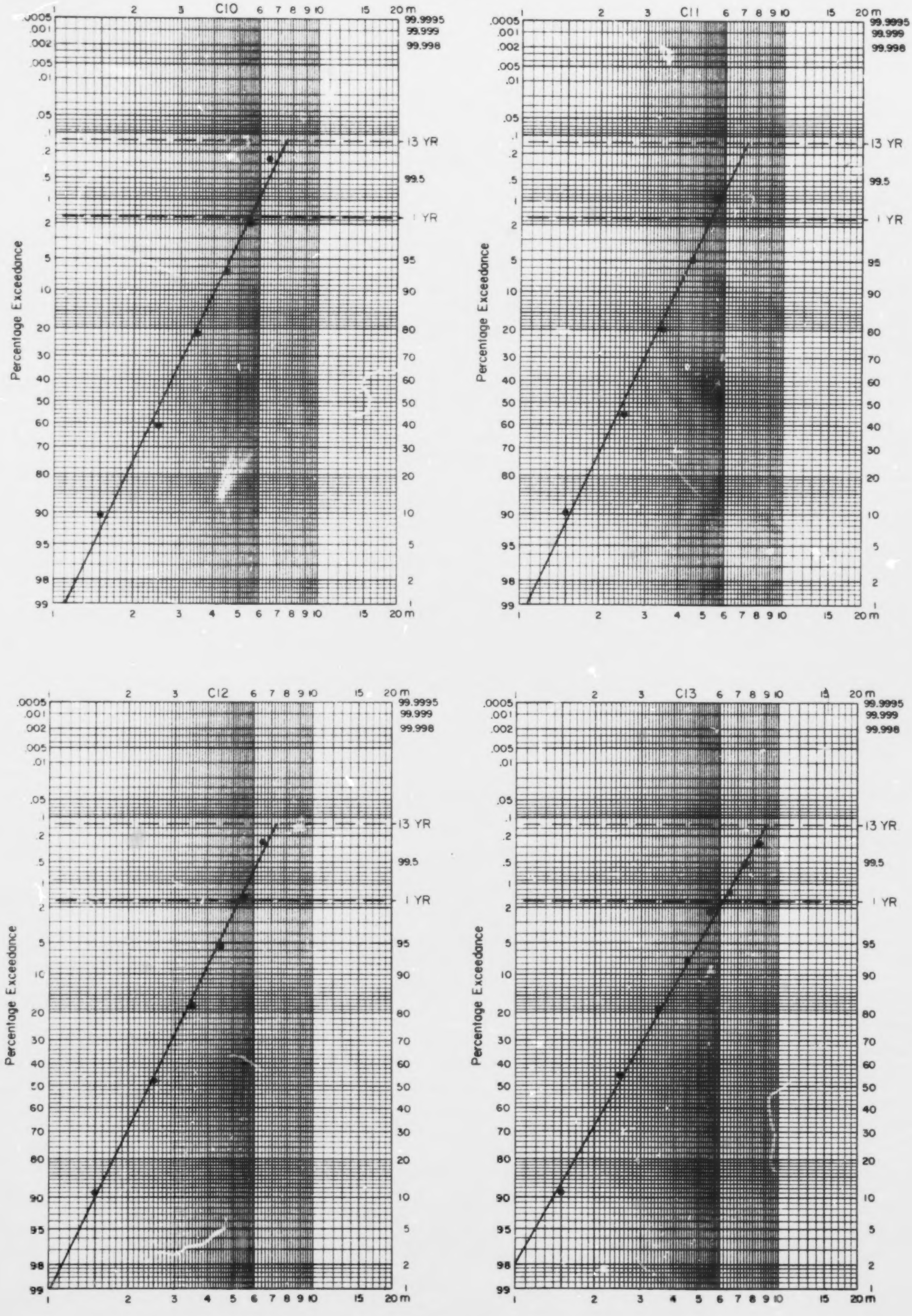


Figure 5j. Monthly Wave Height Exceedance Distribution for May

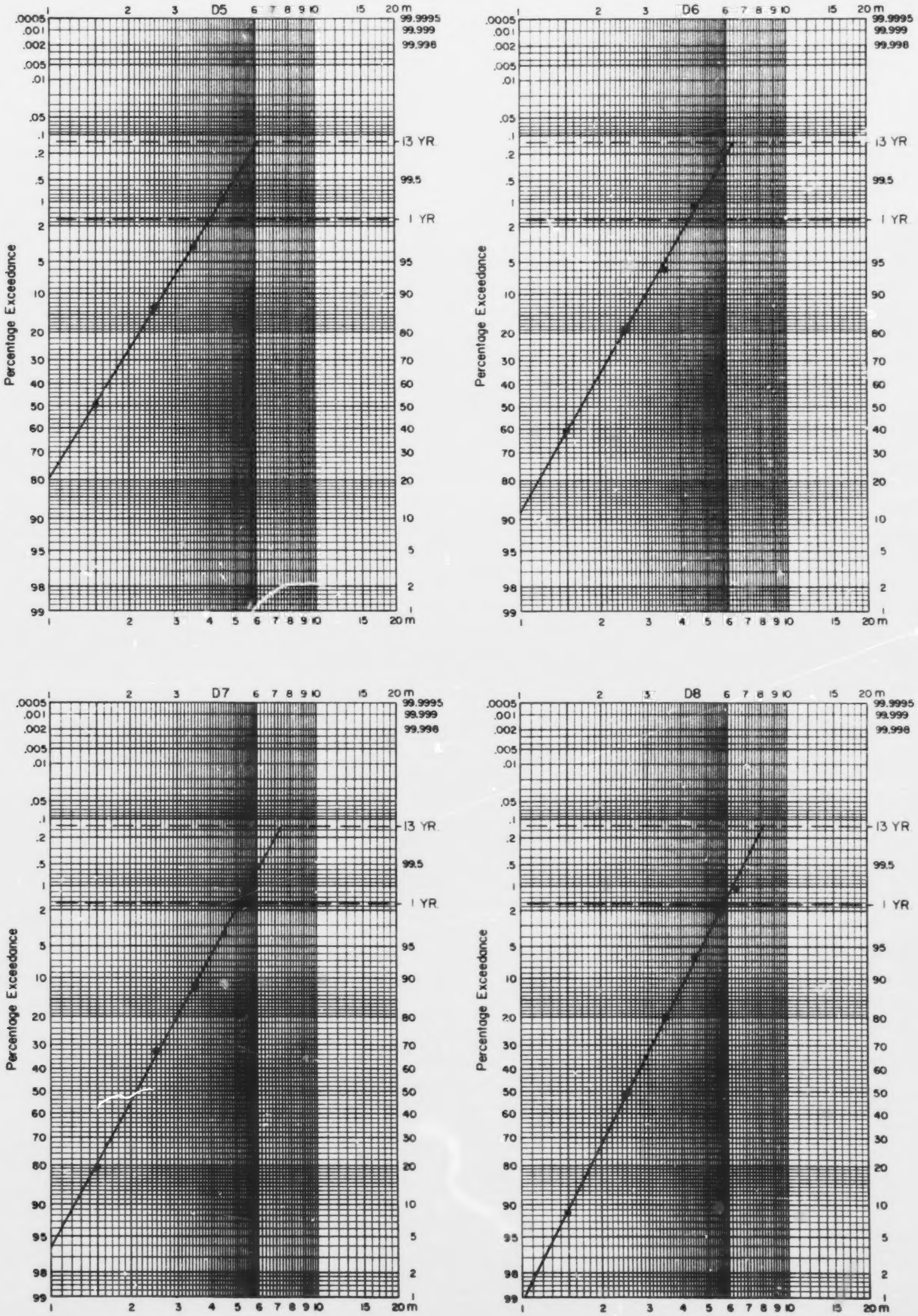


Figure 5k. Monthly Wave Height Exceedance Distribution for May

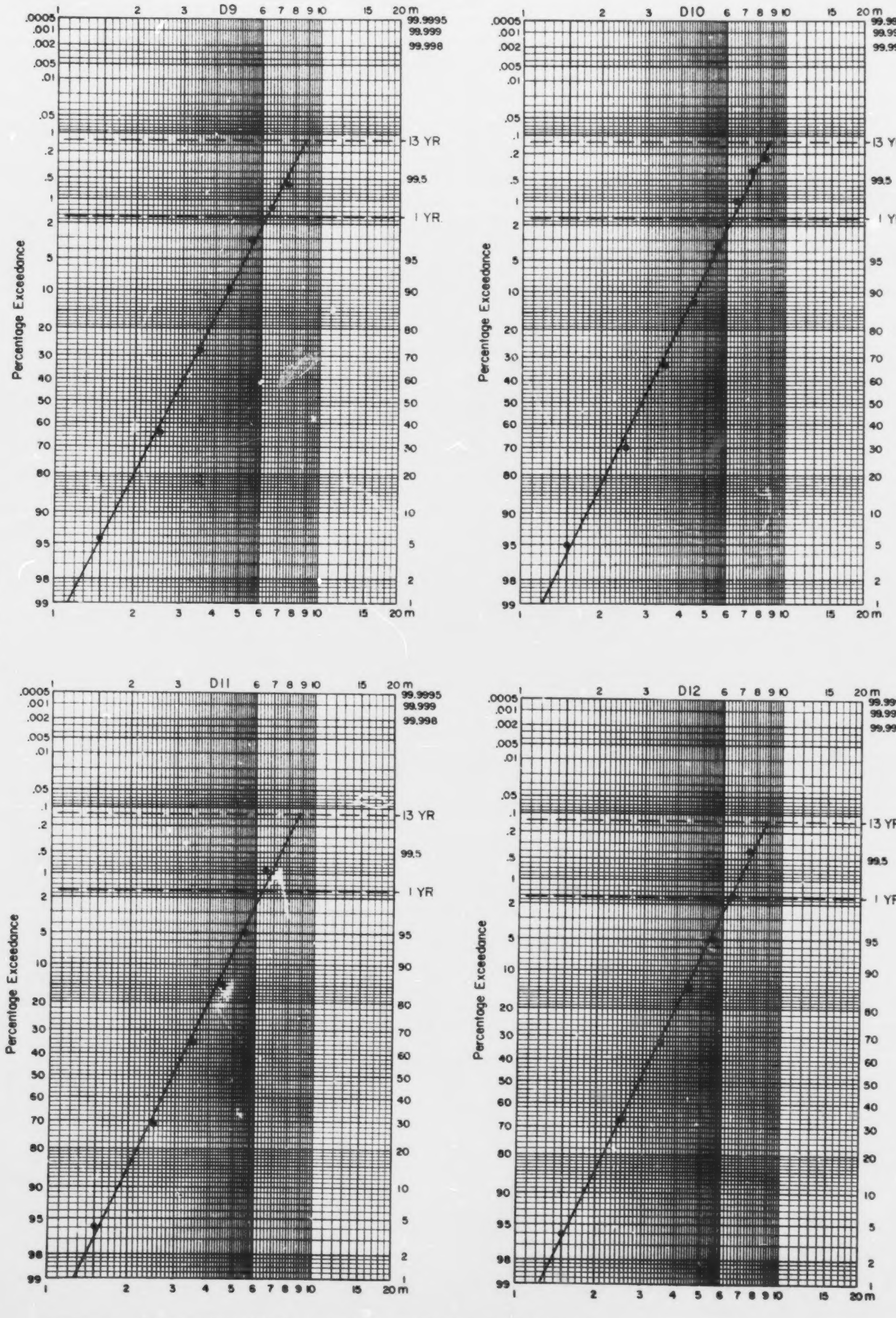
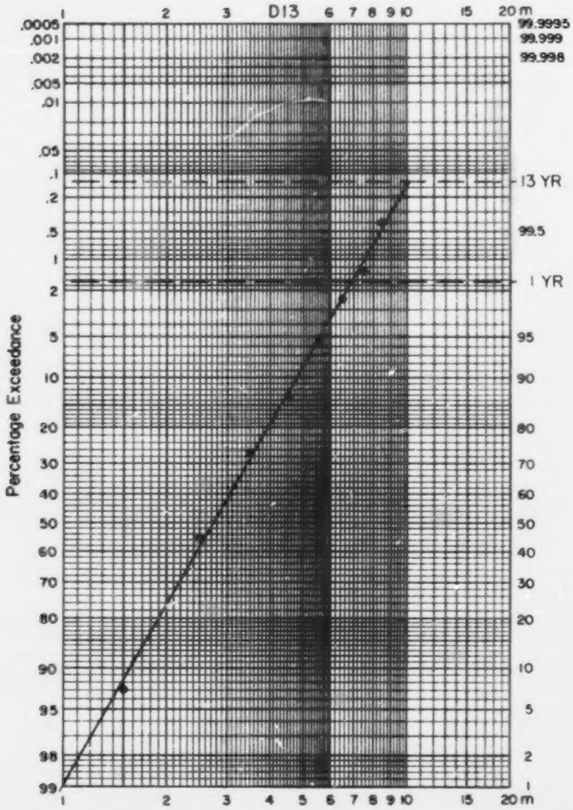
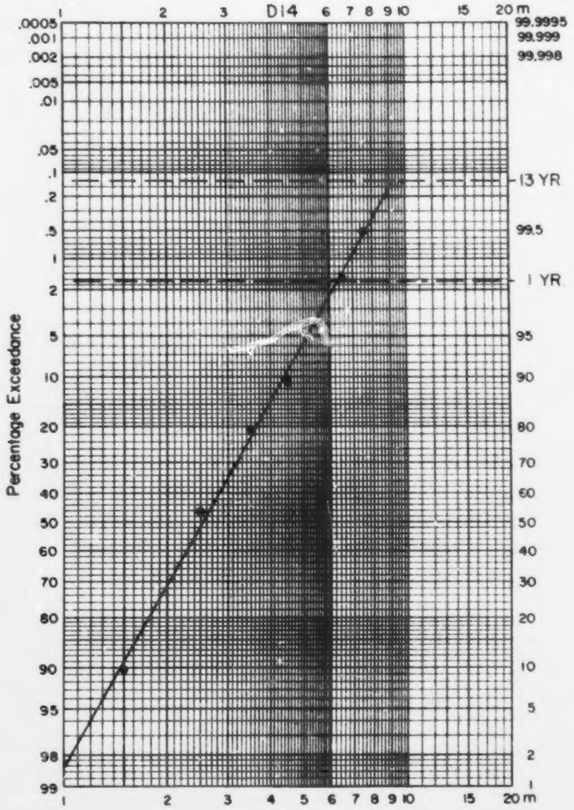
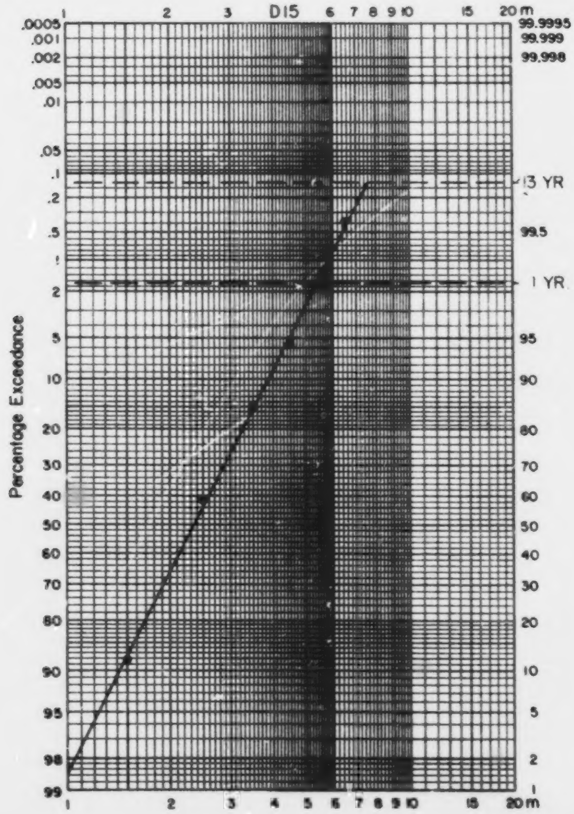


Figure 51. Monthly Wave Height Exceedance Distribution for May







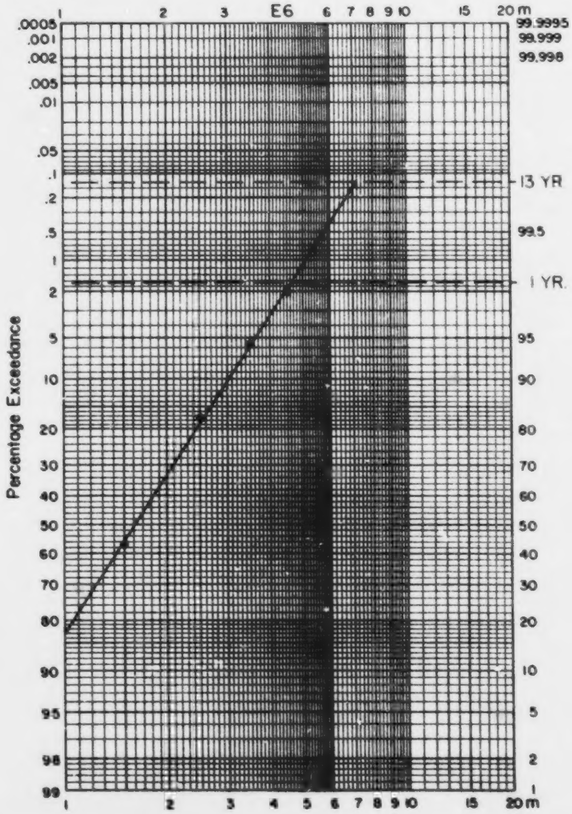


Figure 5m. Monthly Wave Height Exceedance Distribution for May

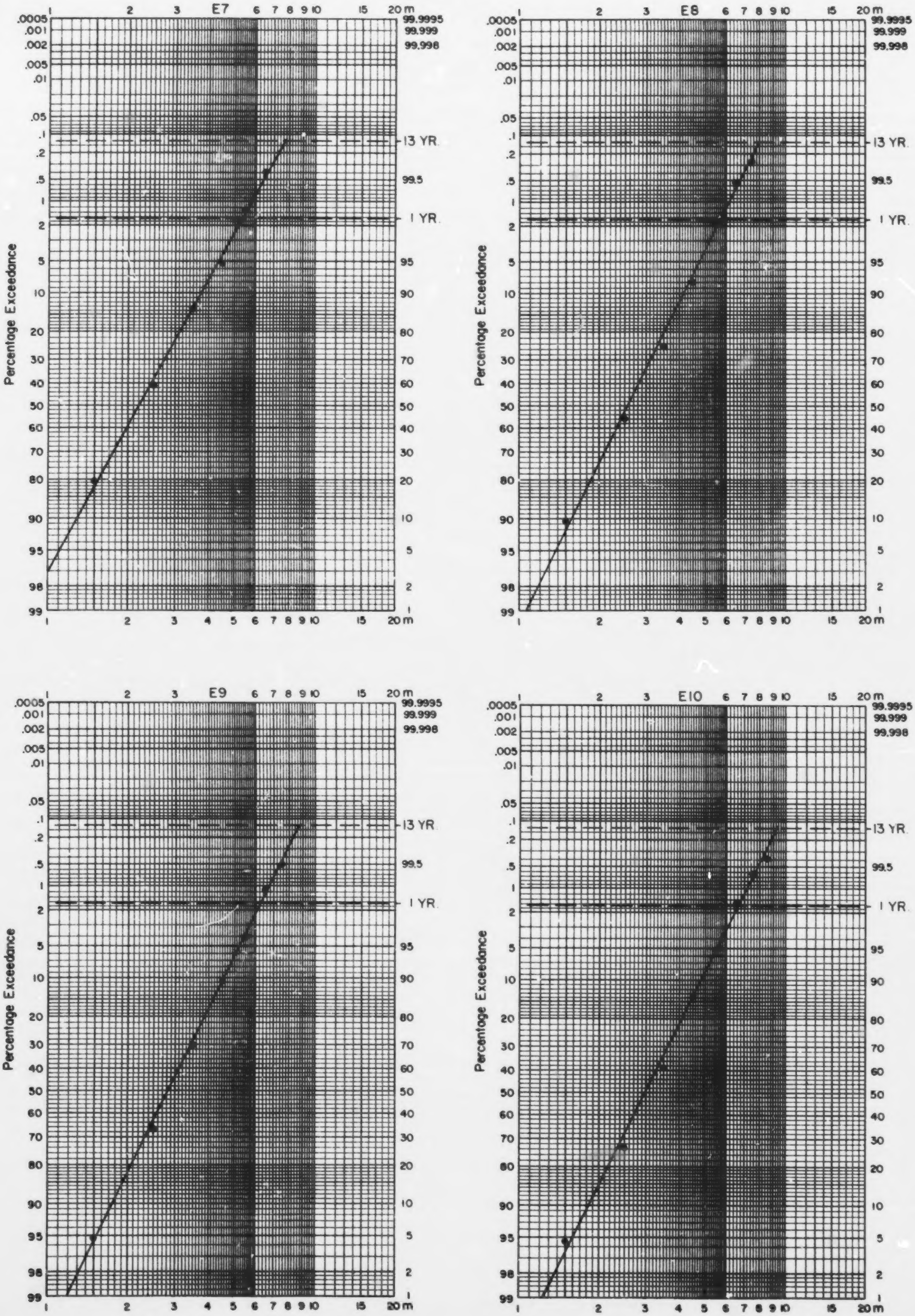


Figure 5n. Monthly Wave Height Exceedance Distribution for May

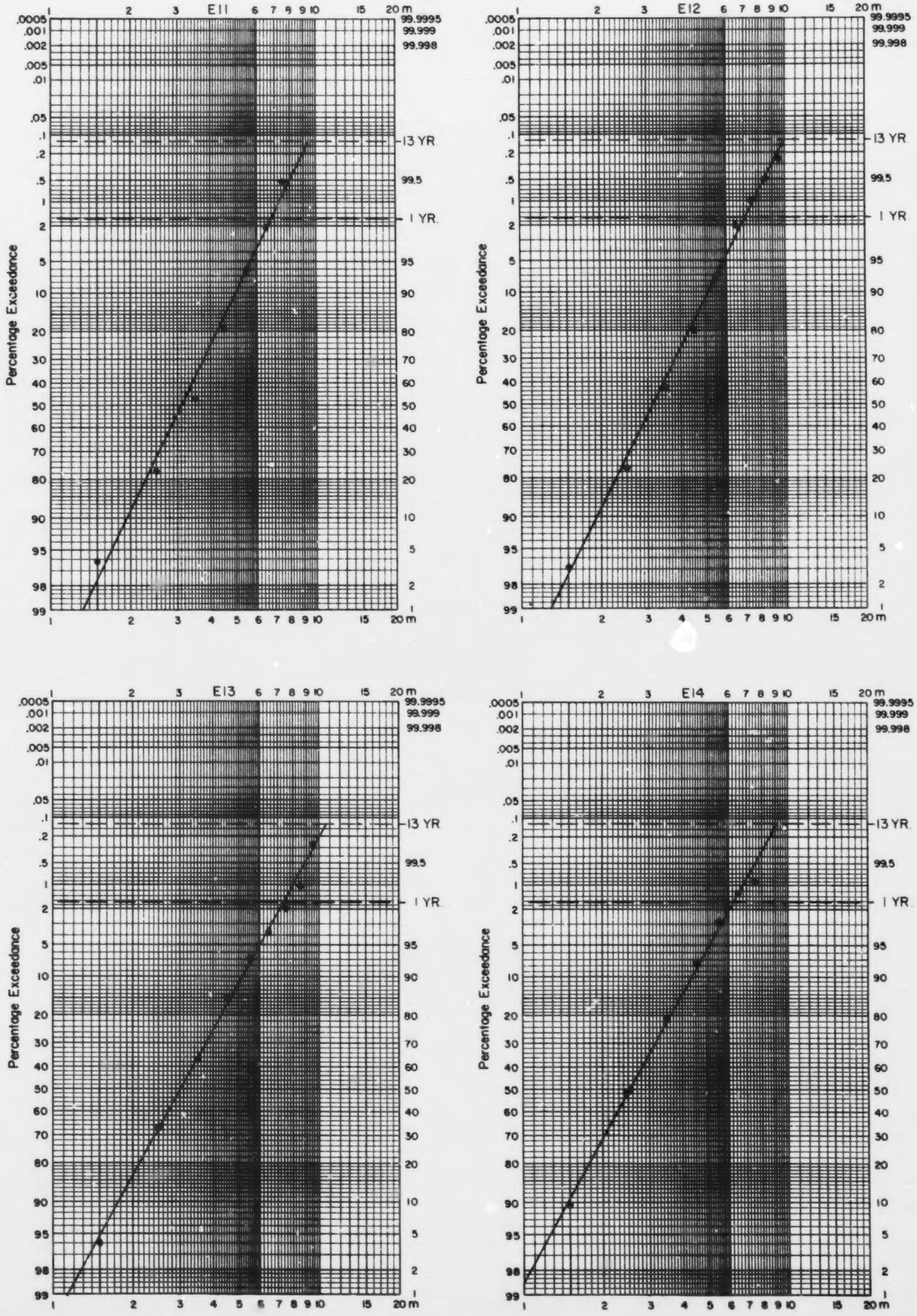


Figure 5o. Monthly Wave Height Exceedance Distribution for May

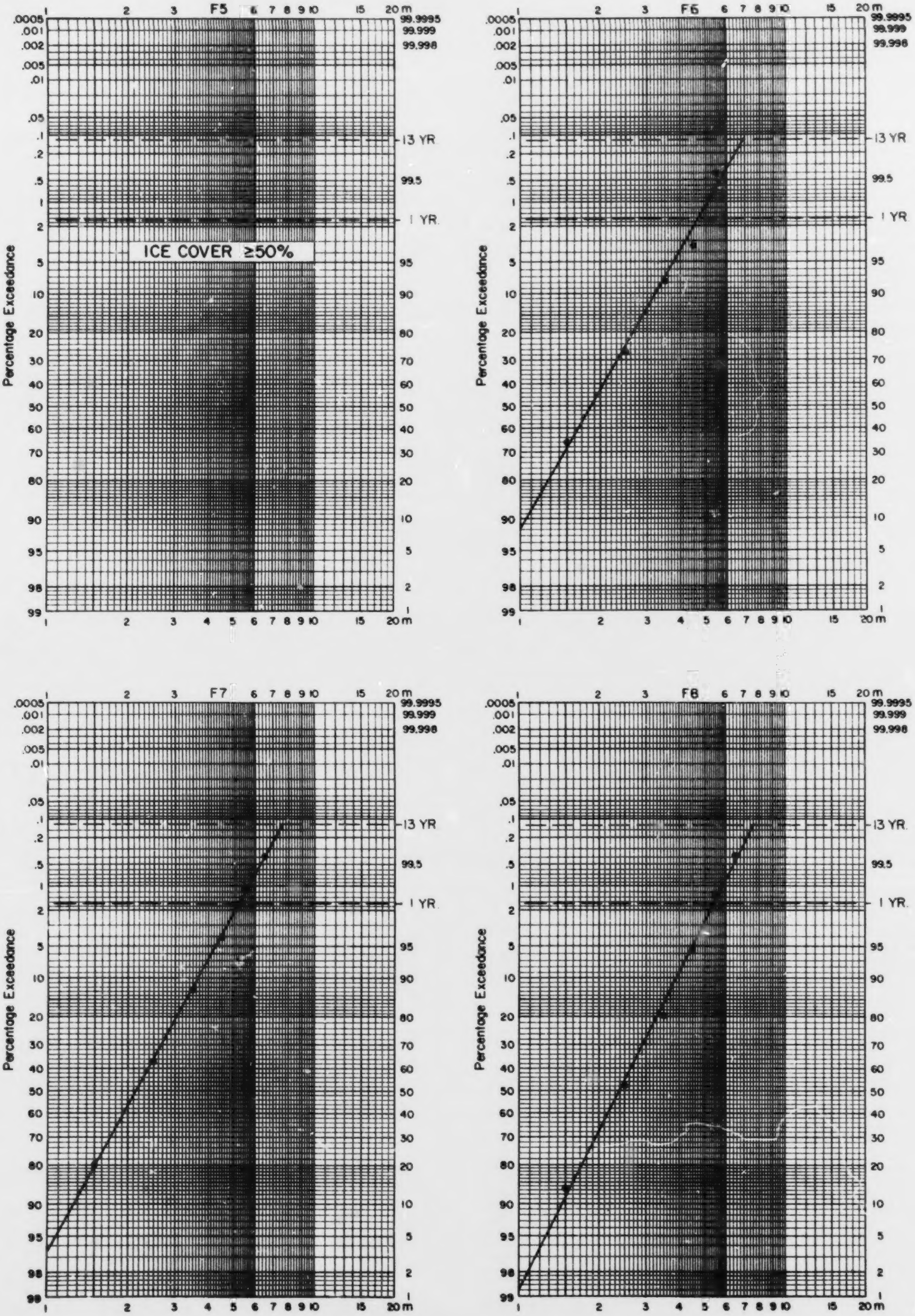


Figure 5p. Monthly Wave Height Exceedance Distribution for May

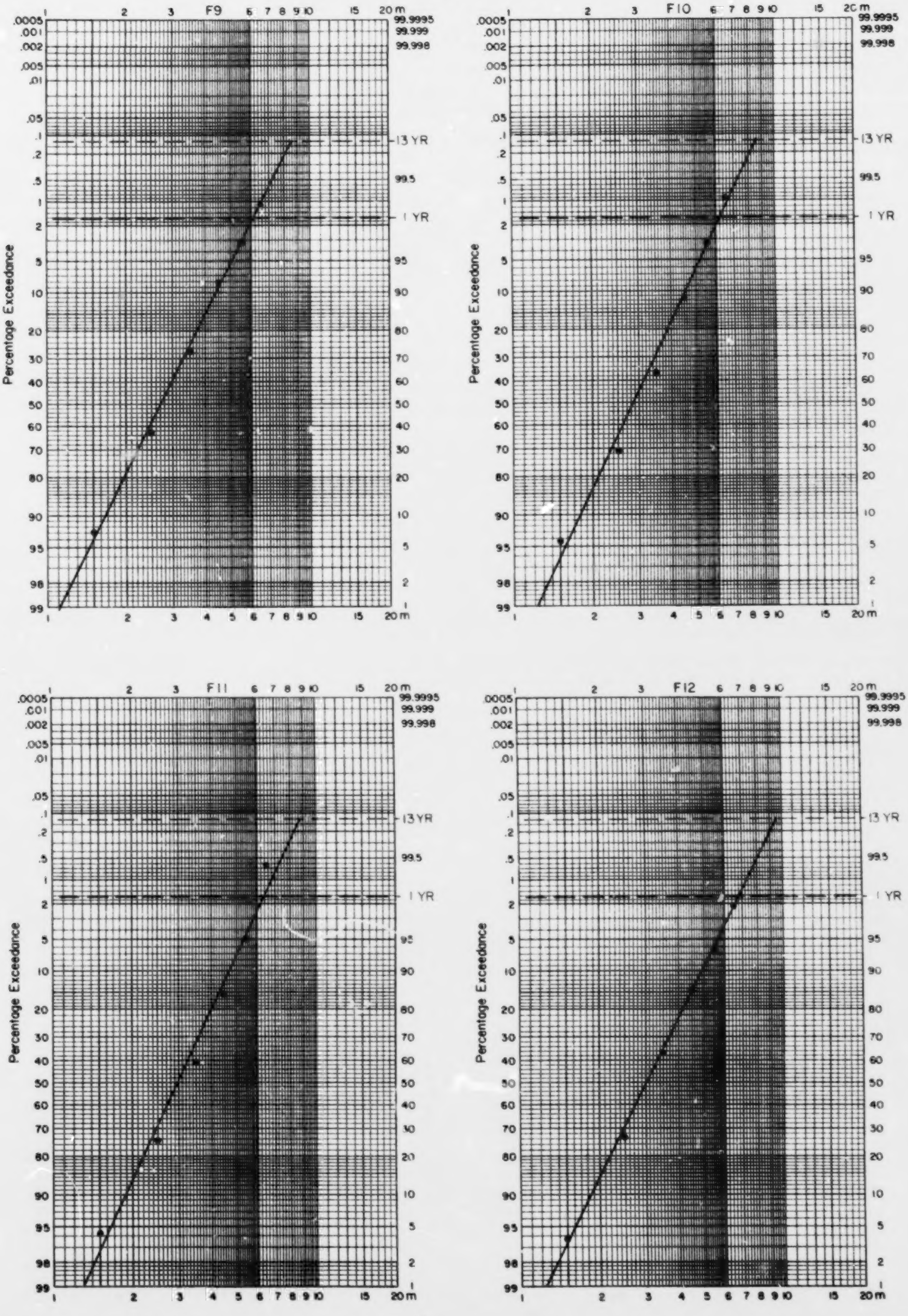


Figure 5q. Monthly Wave Height Exceedance Distribution for May

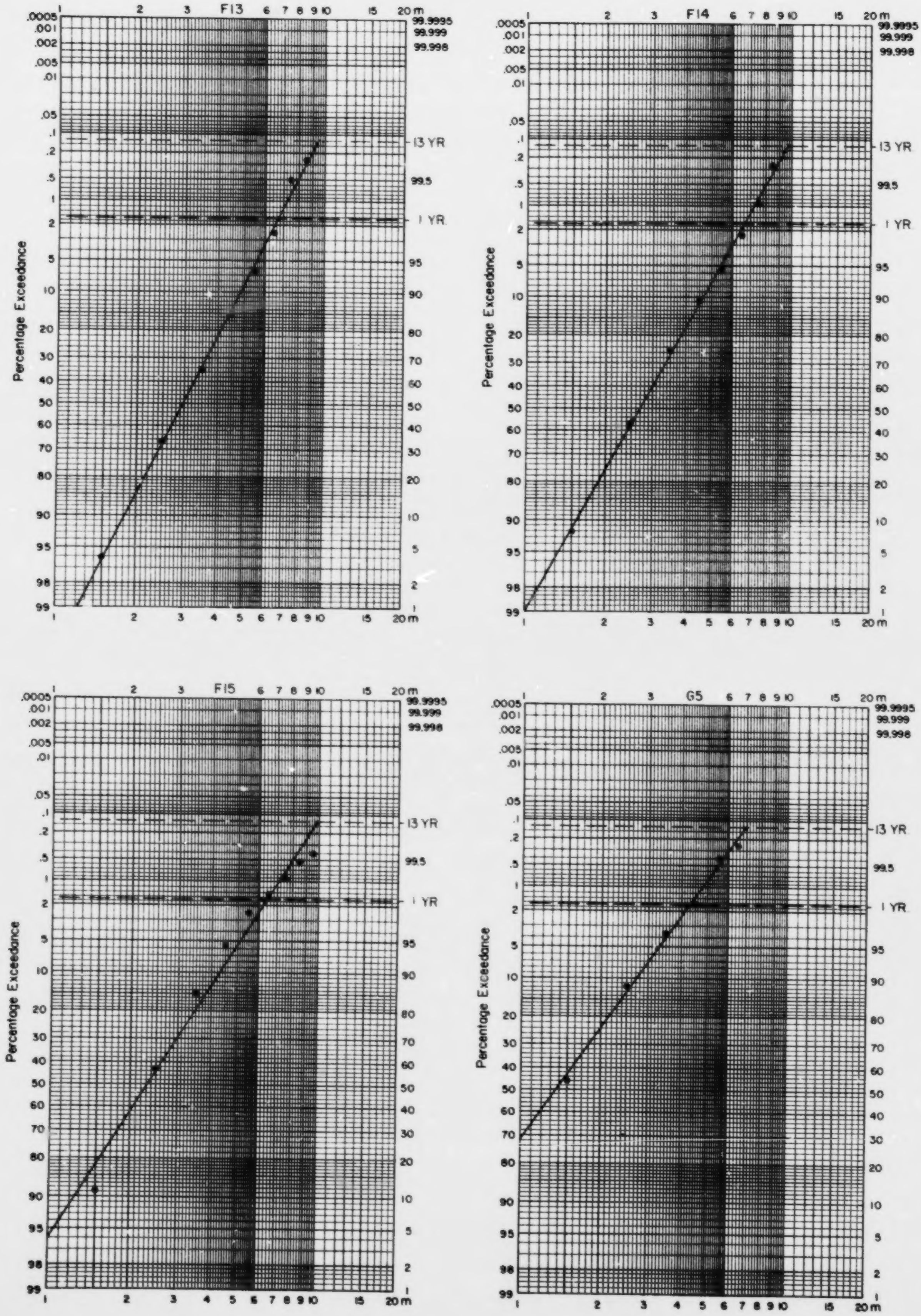


Figure 5r. Monthly Wave Height Exceedance Distribution for May

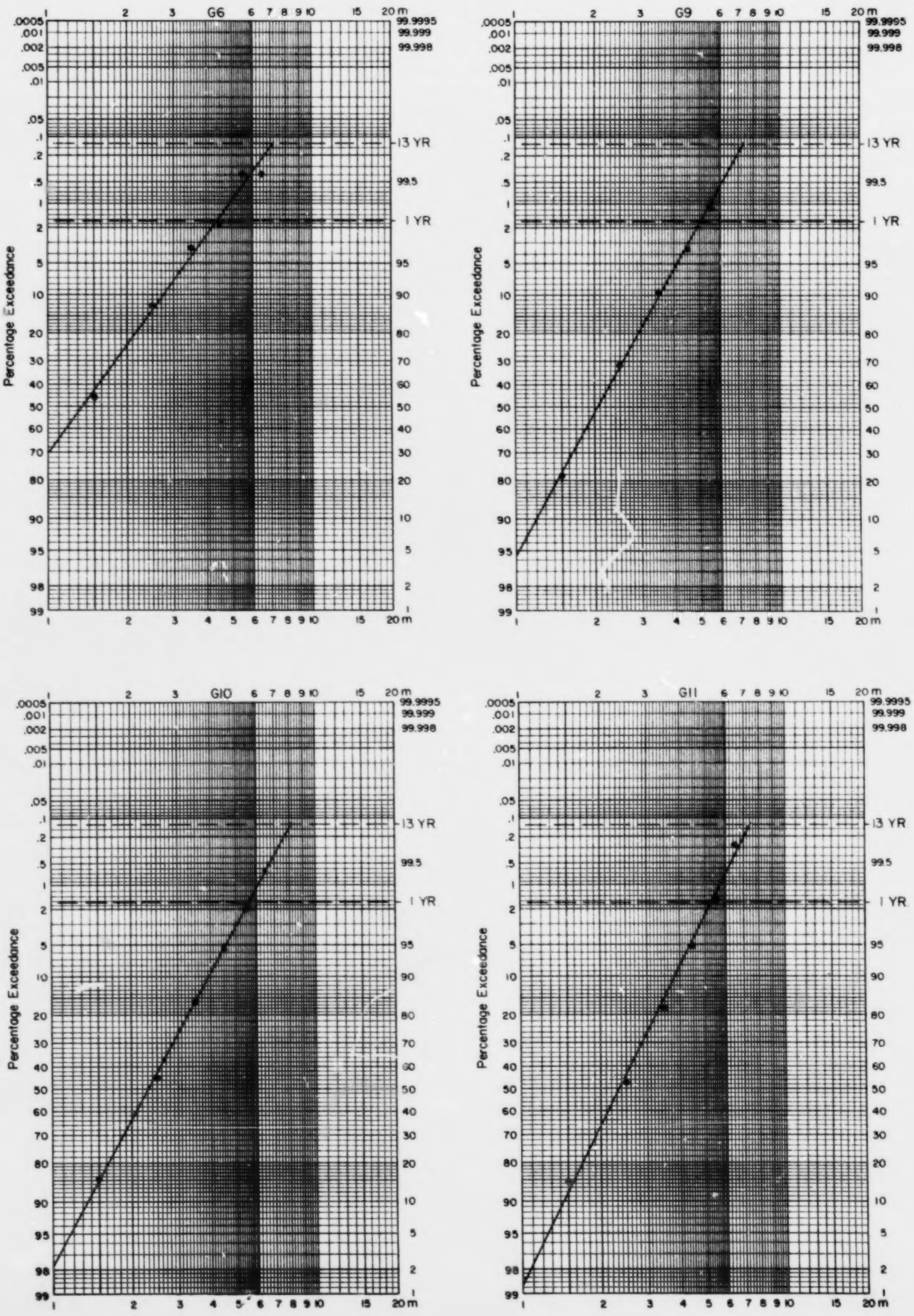


Figure 5s. Monthly Wave Height Exceedance Distribution for May

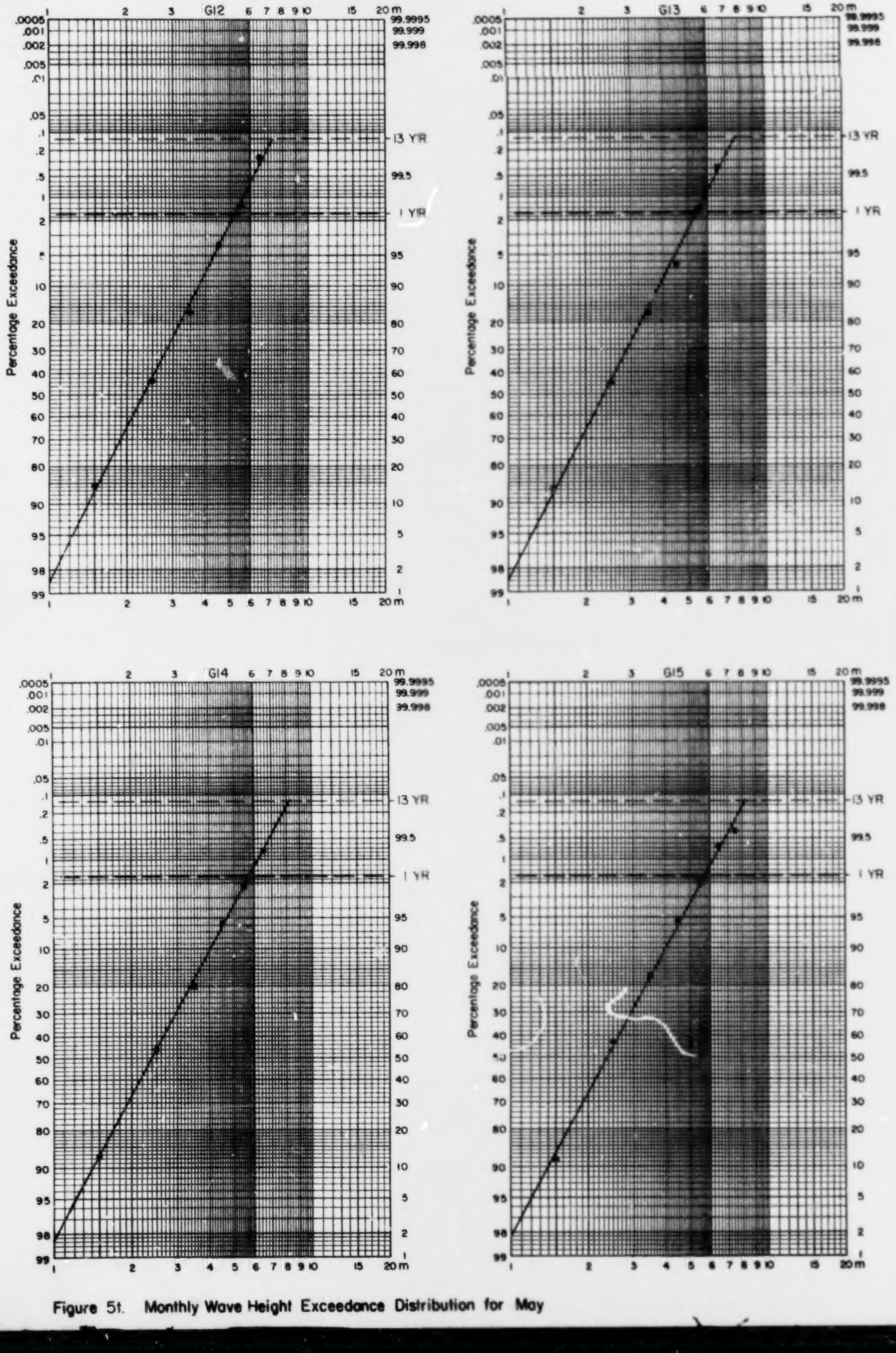


Figure 5t. Monthly Wave Height Exceedance Distribution for May

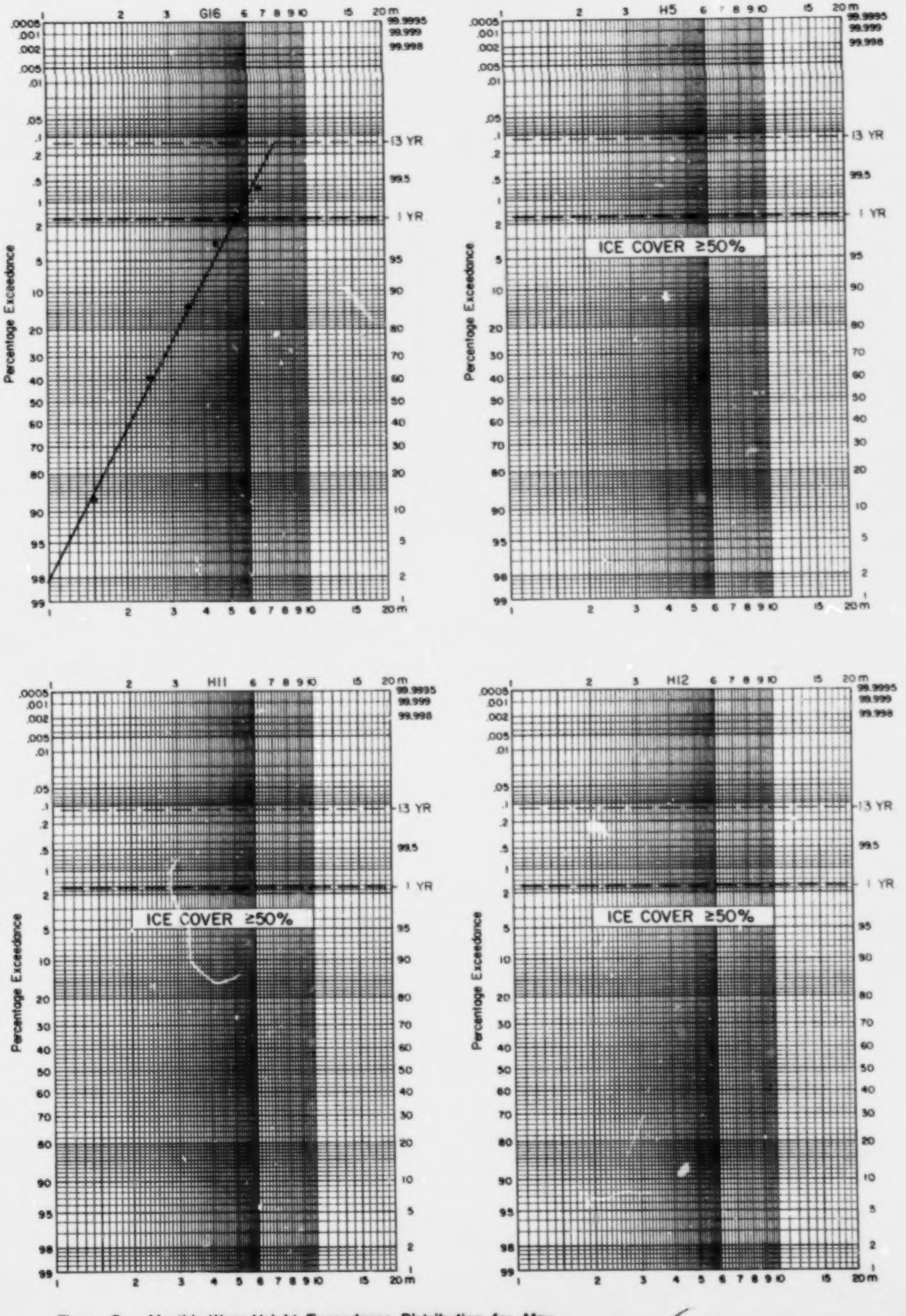


Figure 5u. Monthly Wave Height Exceedance Distribution for May

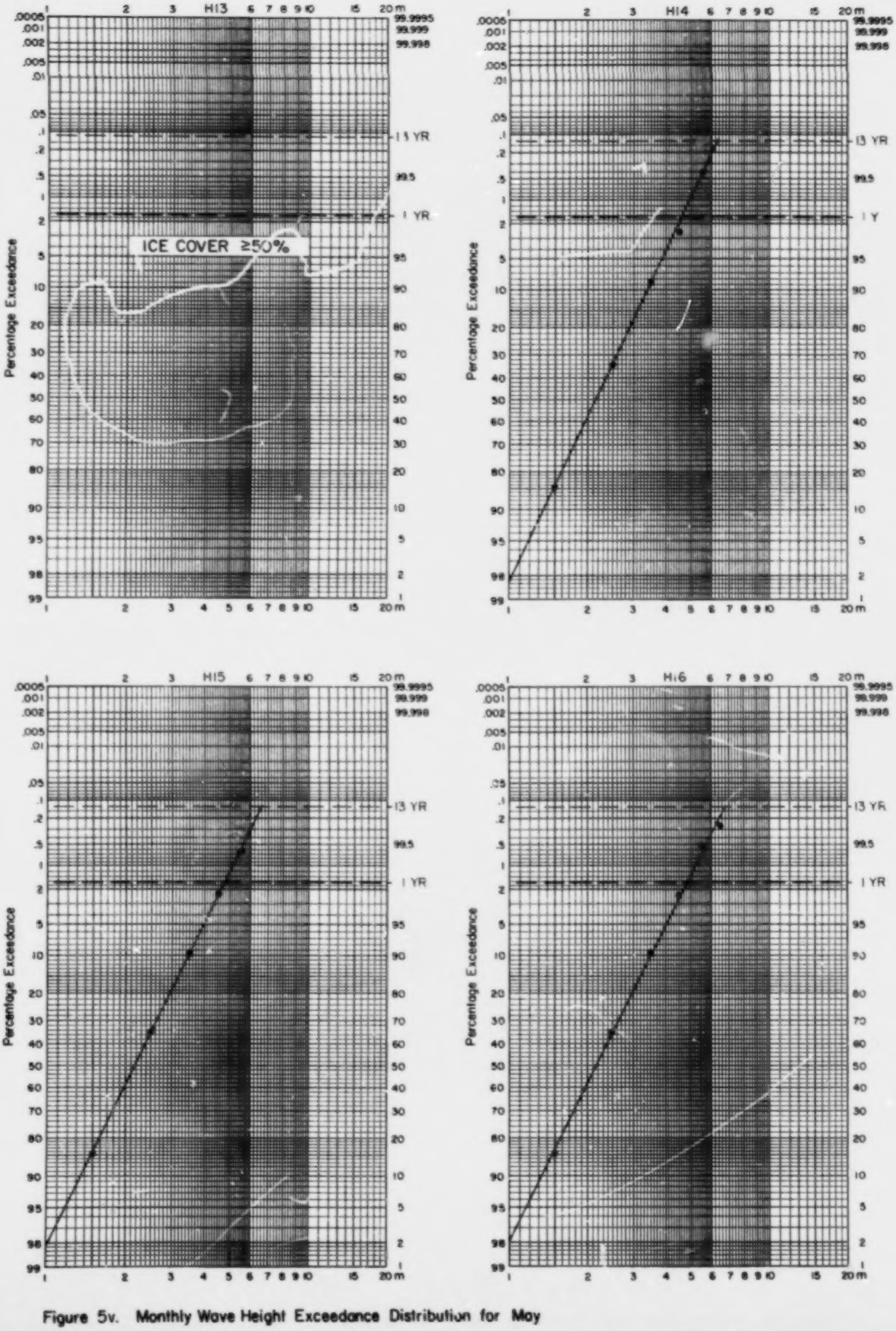


Figure 5v. Monthly Wave Height Exceedance Distribution for May

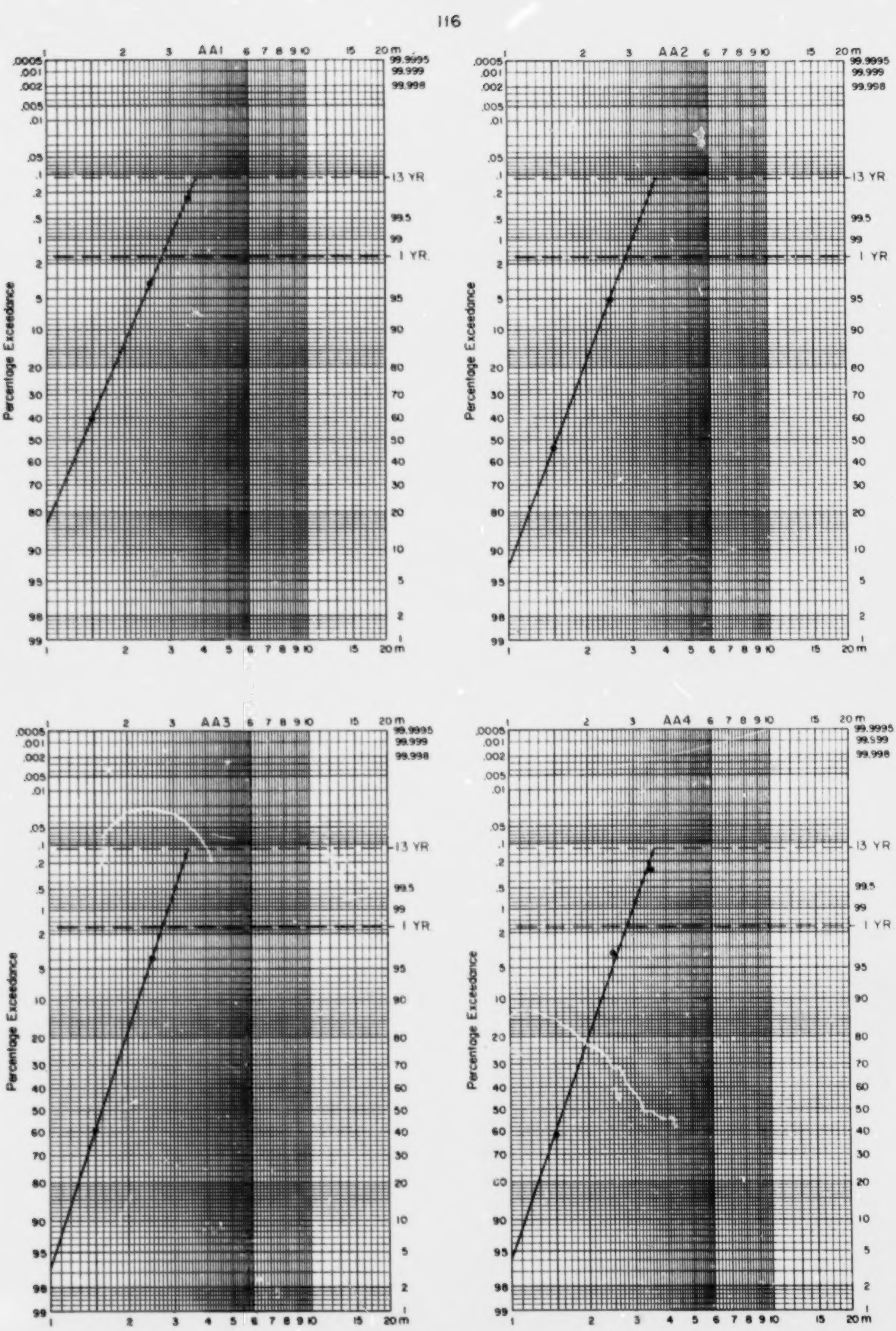


Figure 6a. Monthly Wave Height Exceedance Distribution for June

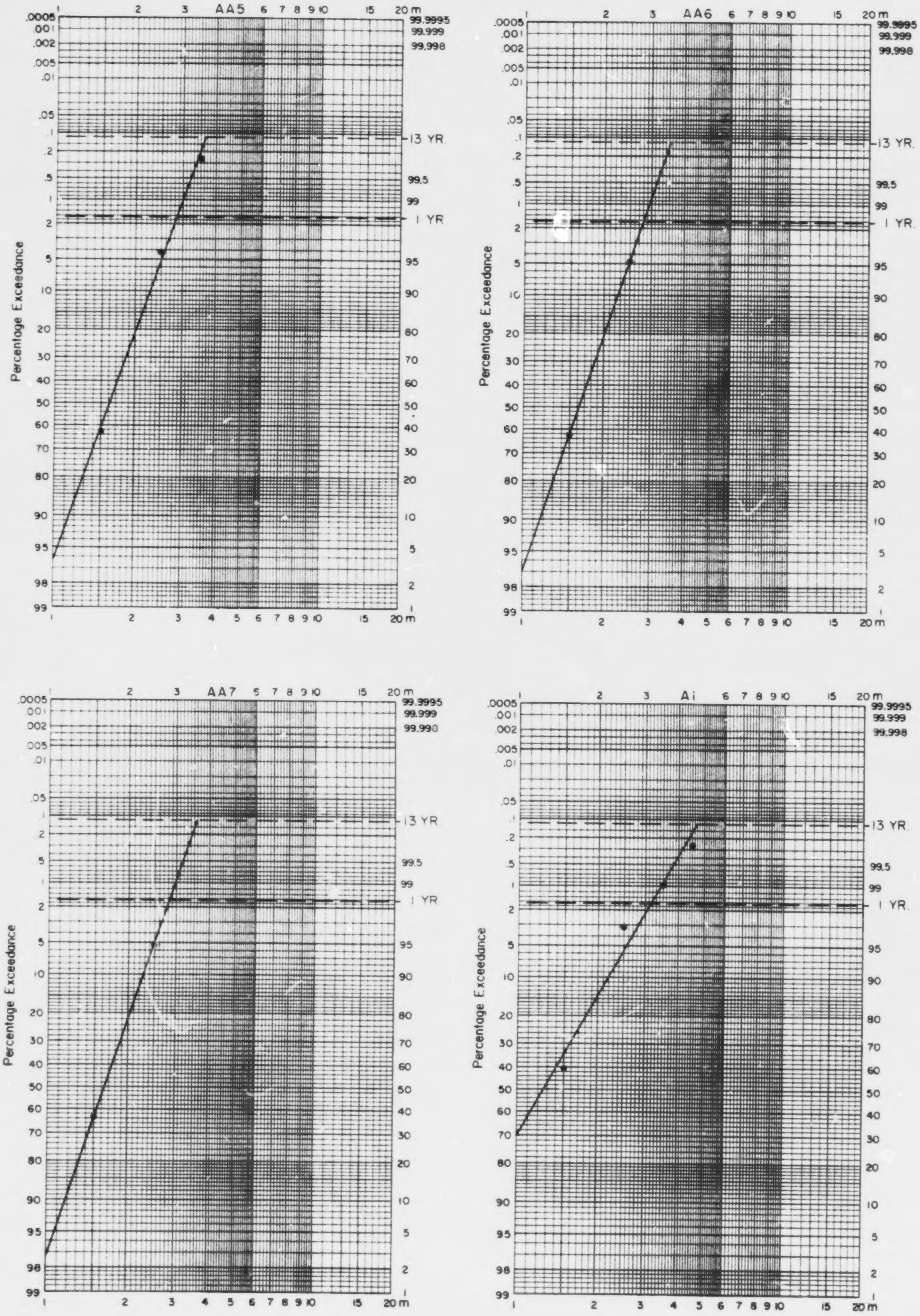
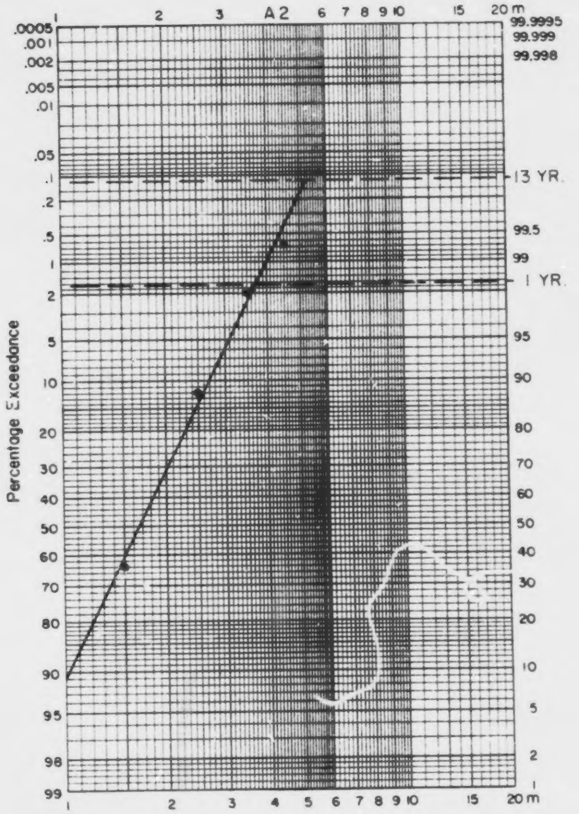
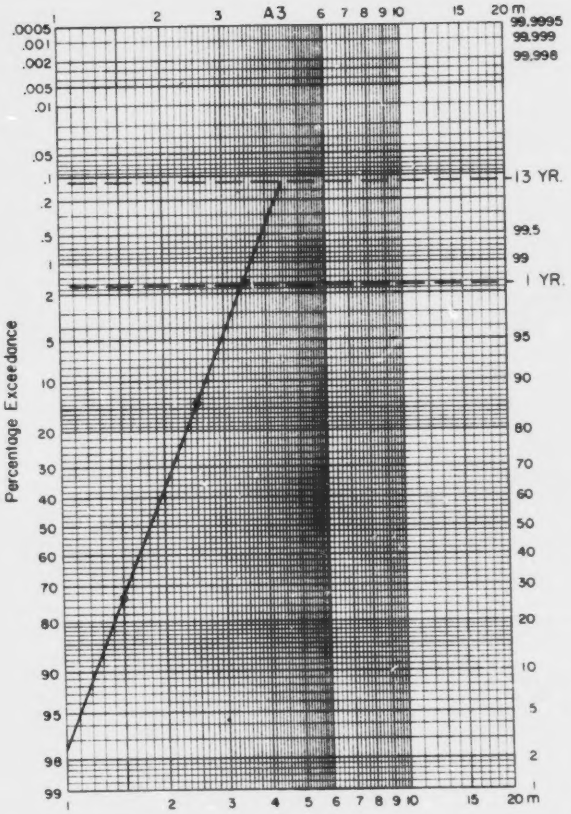
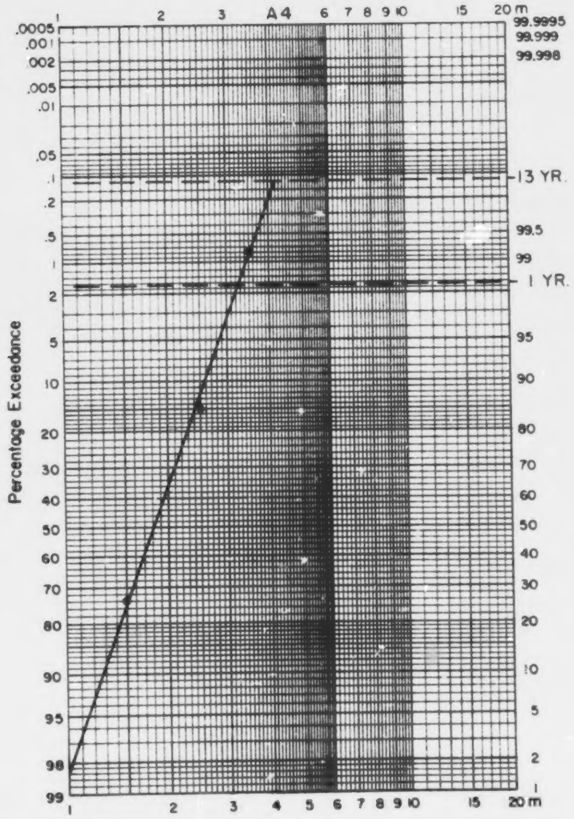


Figure 6b. Monthly Wave Height Exceedance Distribution for June







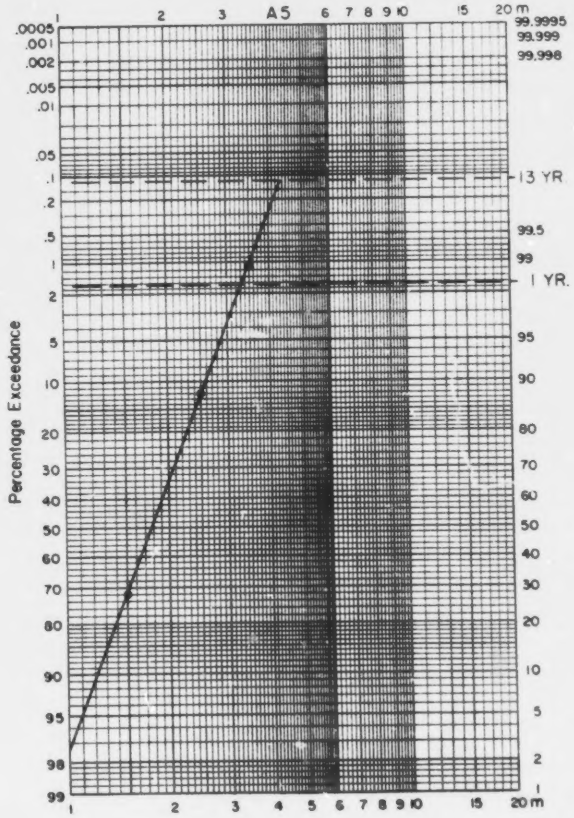


Figure 6c. Monthly Wave Height Exceedance Distribution for June

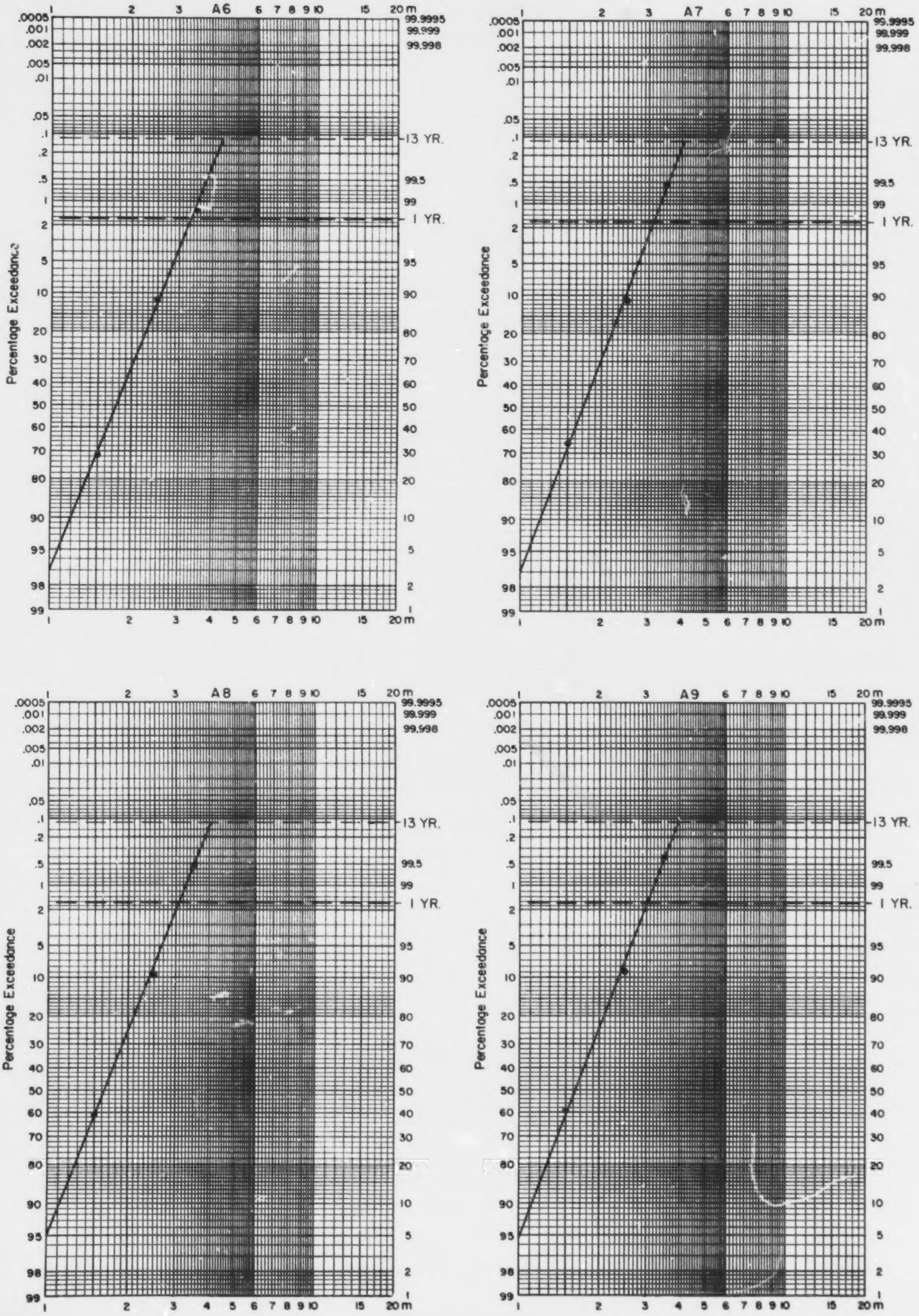


Figure 6d. Monthly Wave Height Exceedance Distribution for June

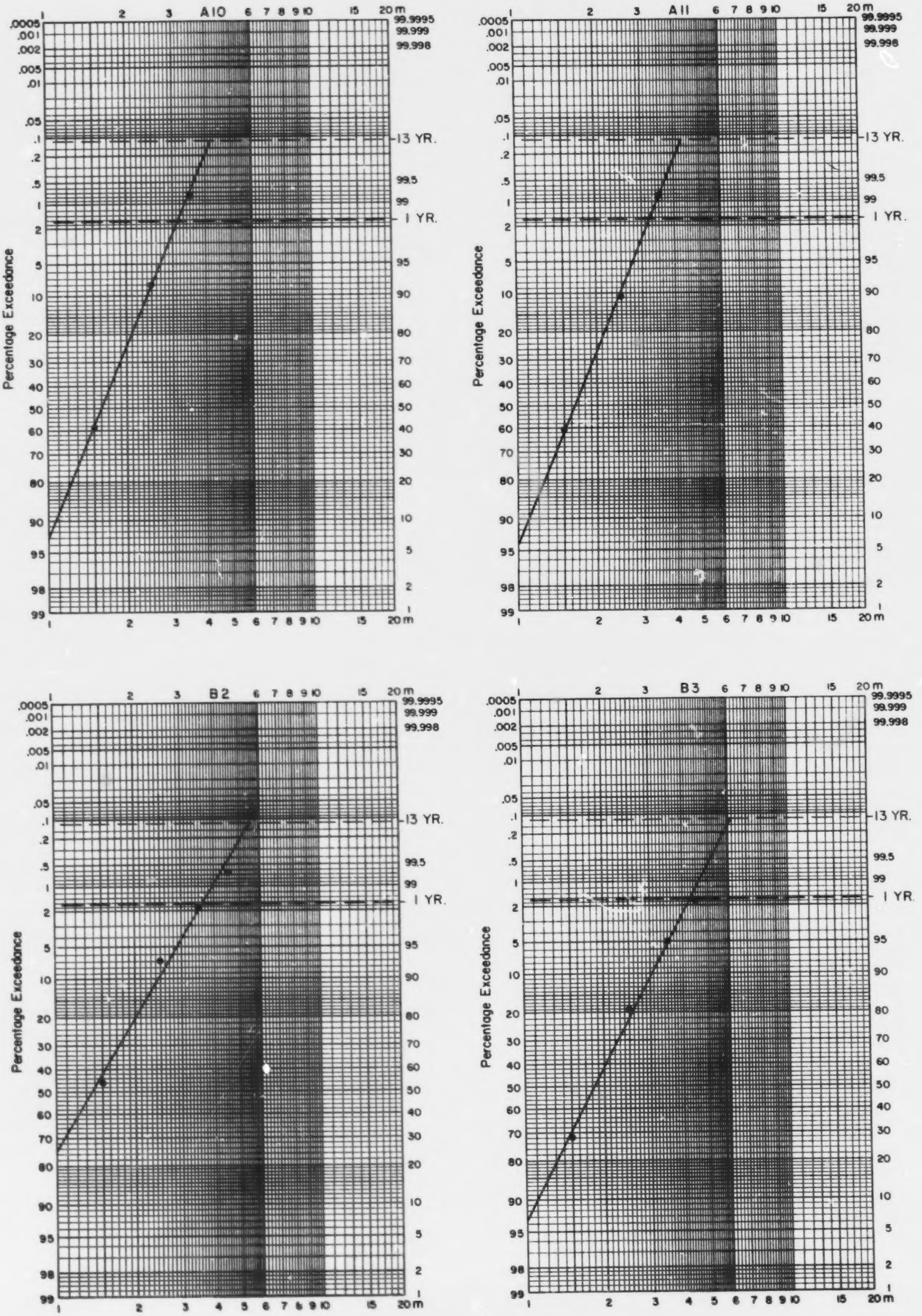


Figure 6e. Monthly Wave Height Exceedance Distribution for June

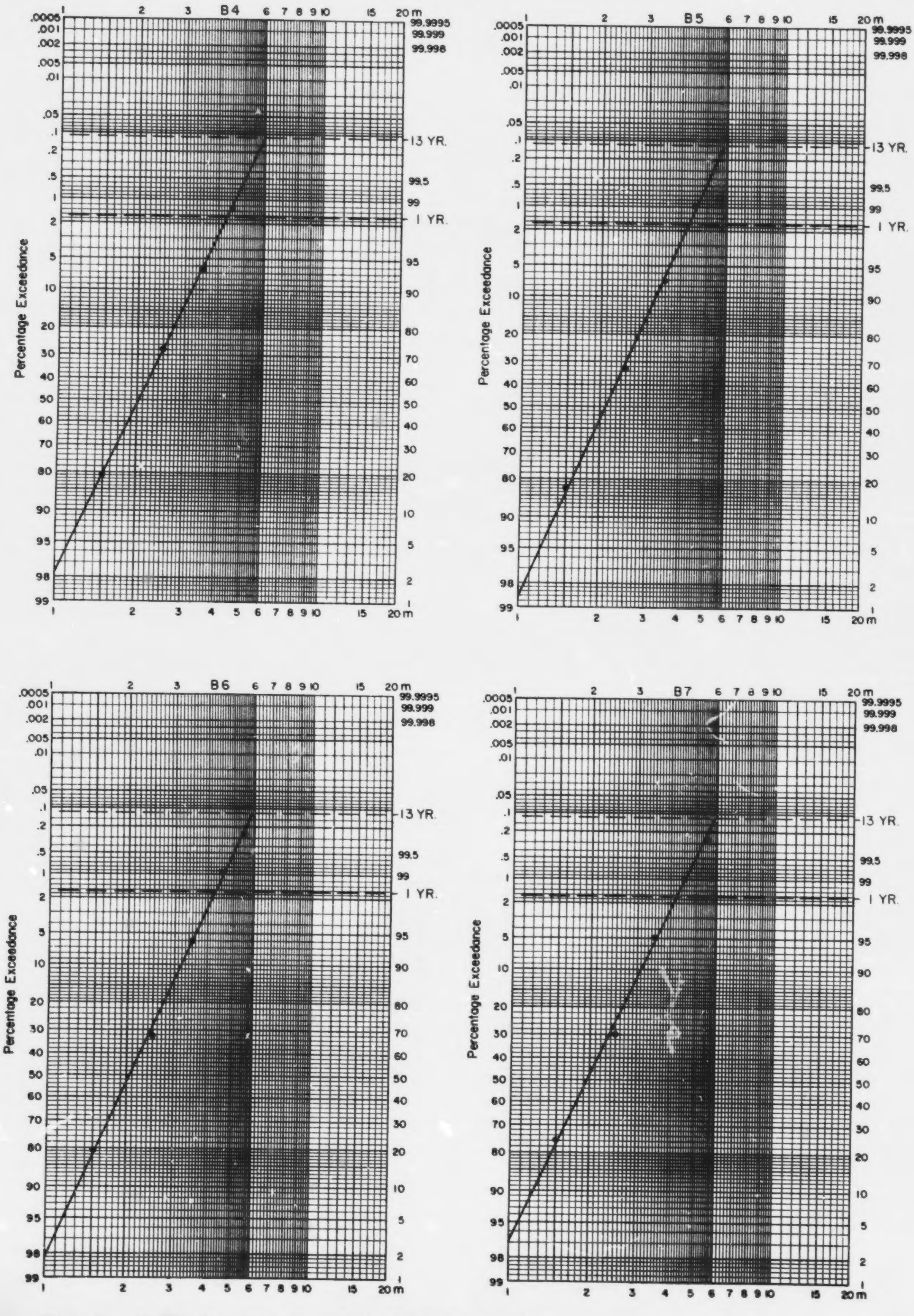


Figure 6f. Monthly Wave Height Exceedance Distribution for June

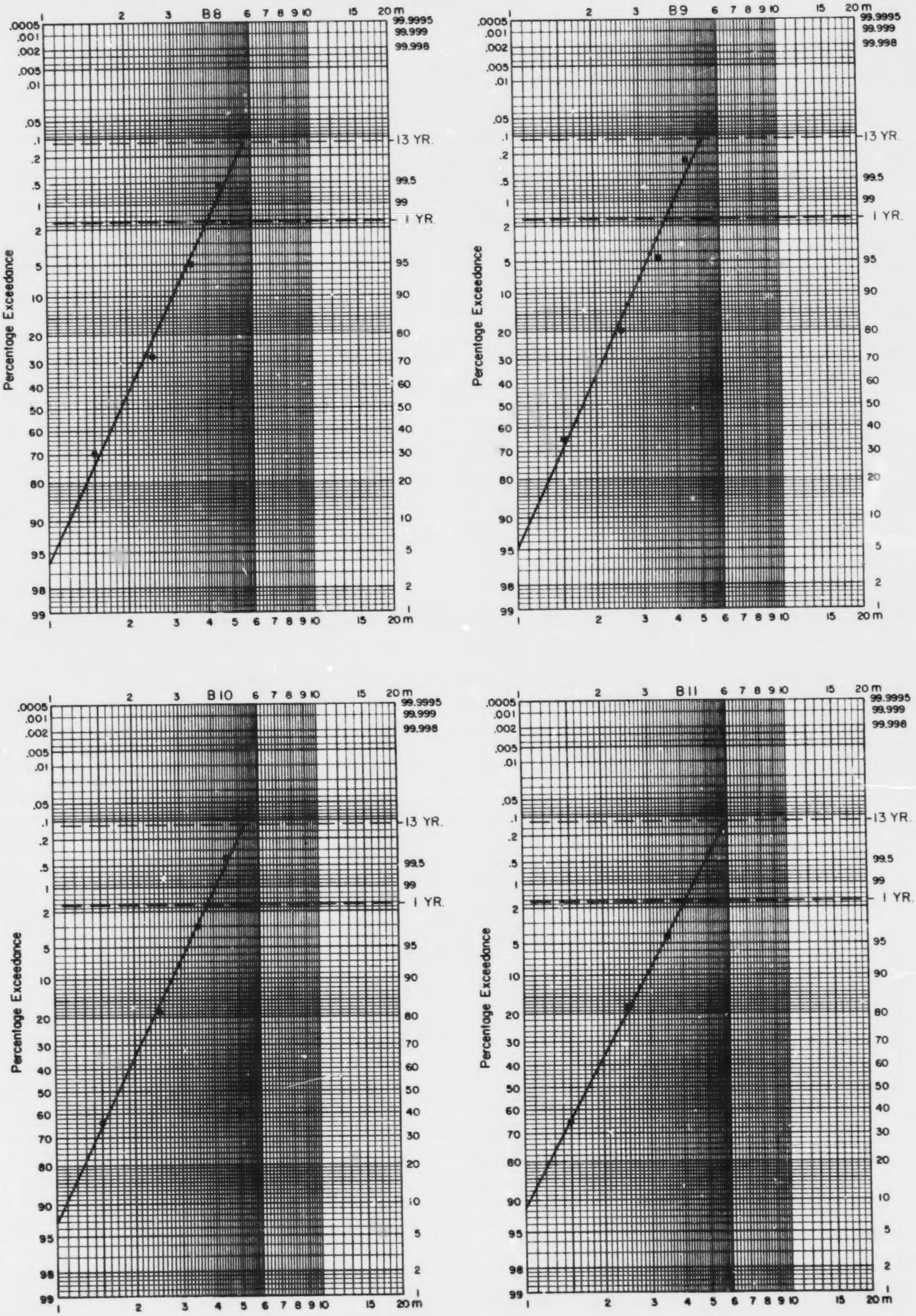


Figure 6g. Monthly Wave Height Exceedance Distribution for June

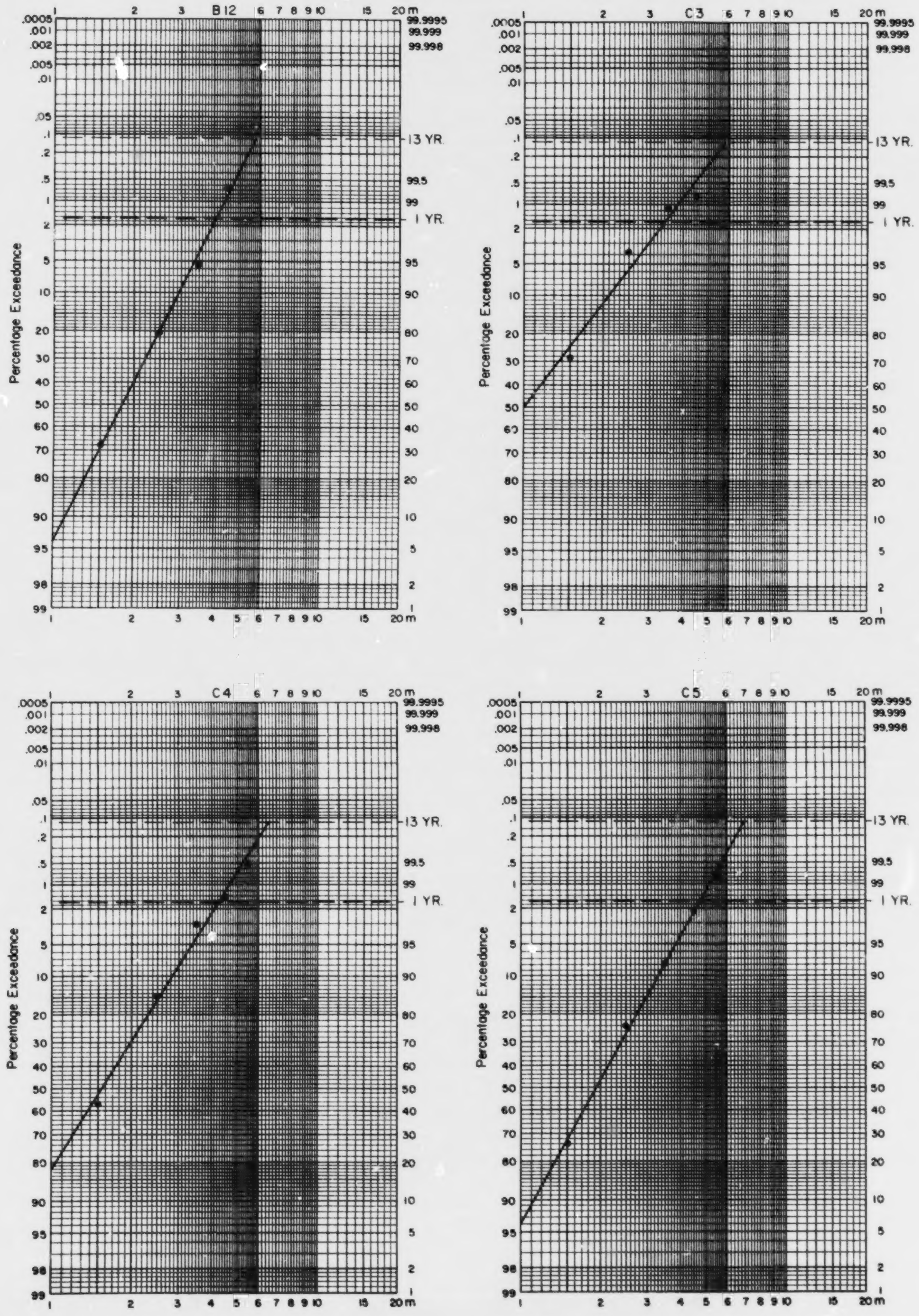


Figure 6h. Monthly Wave Height Exceedance Distribution for June

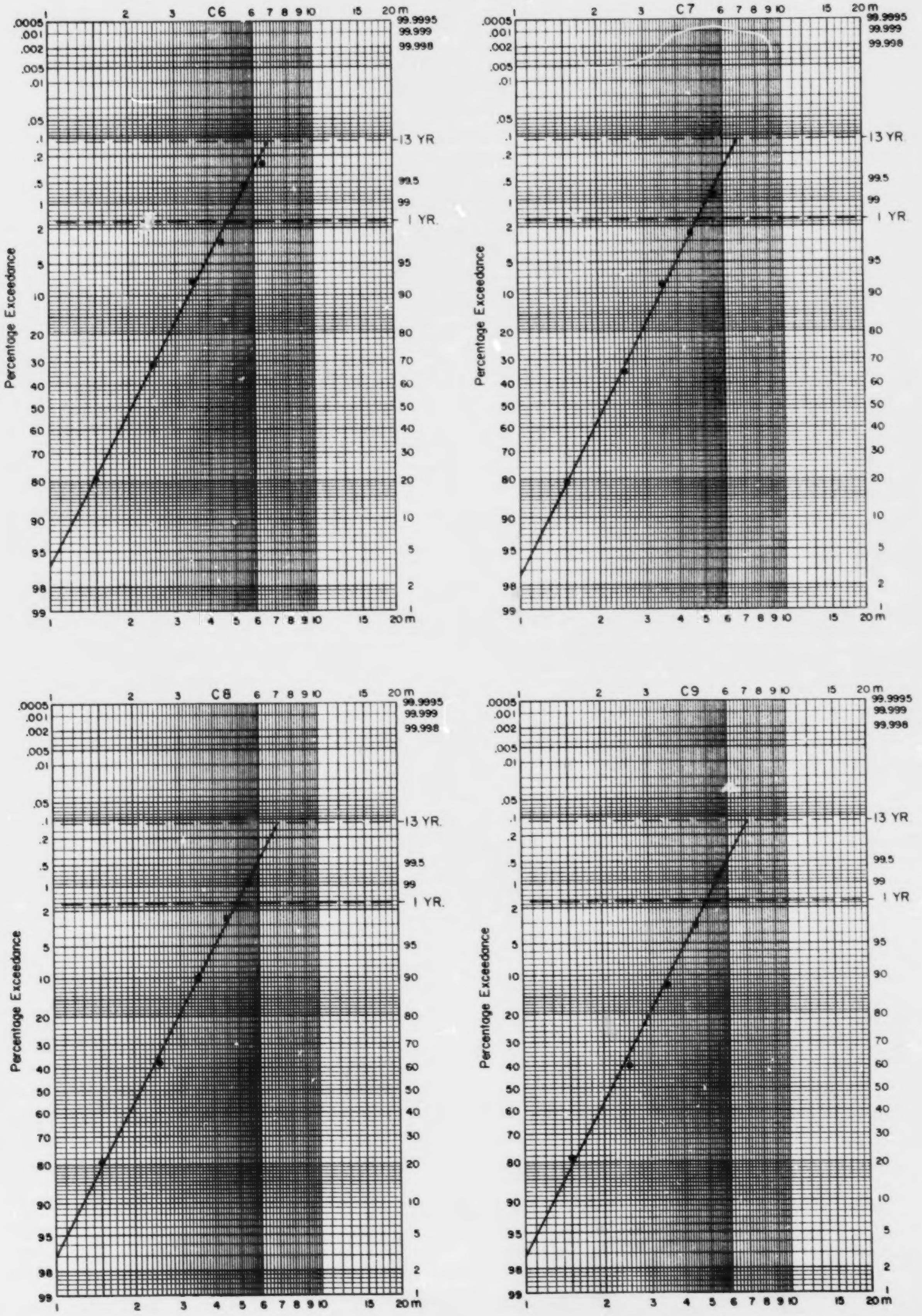
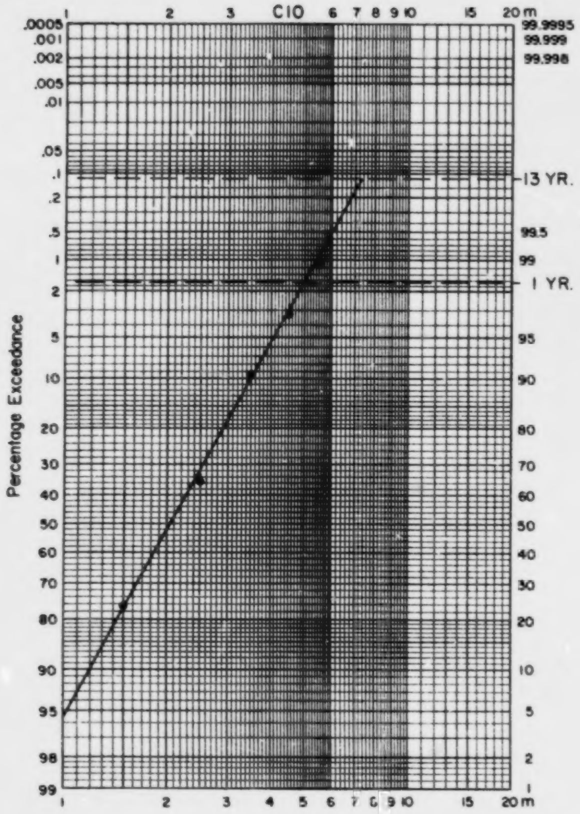
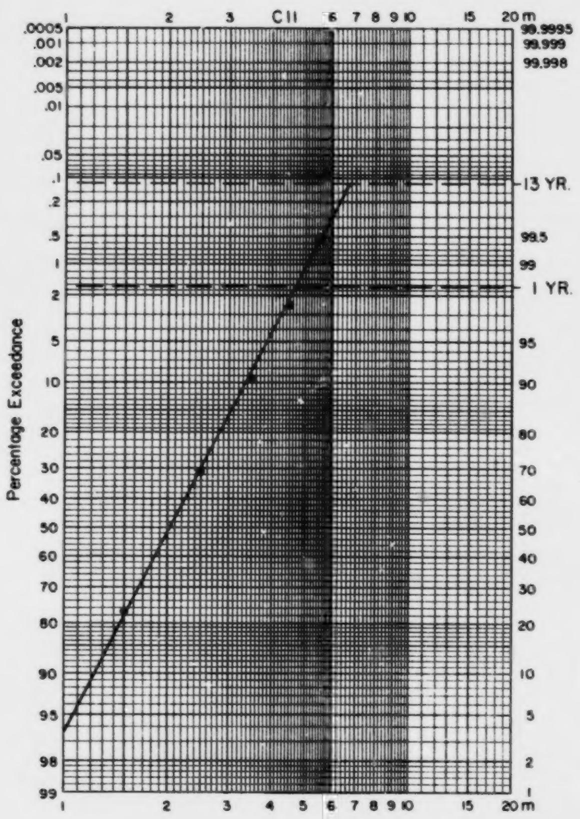
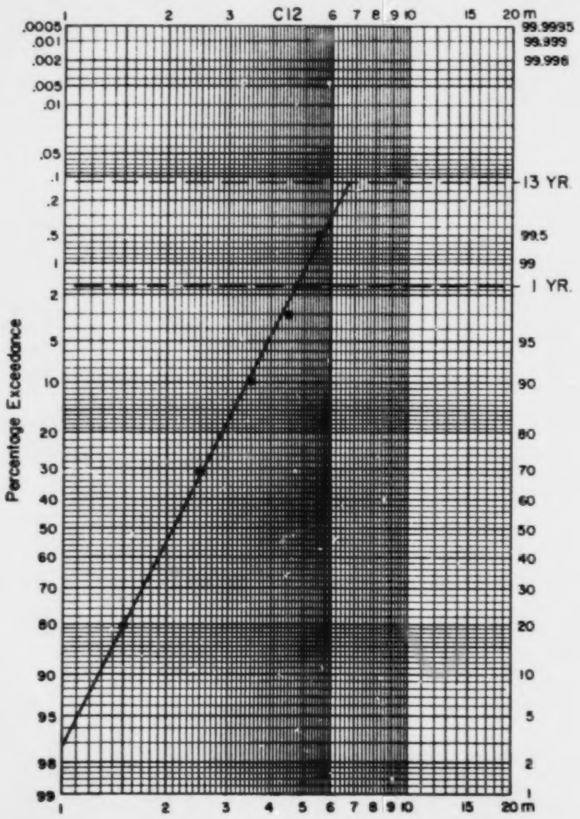


Figure 6i. Monthly Wave Height Exceedance Distribution for June







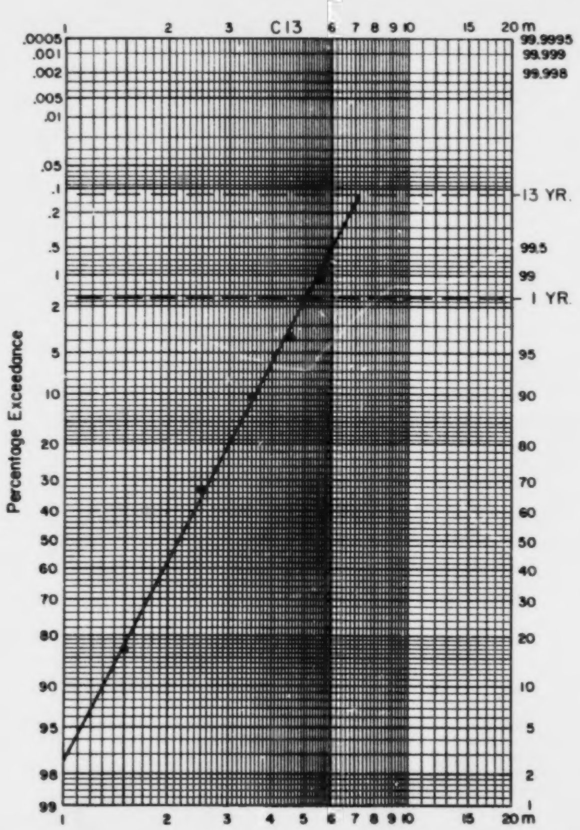


Figure 6j. Monthly Wave Height Exceedance Distribution for June

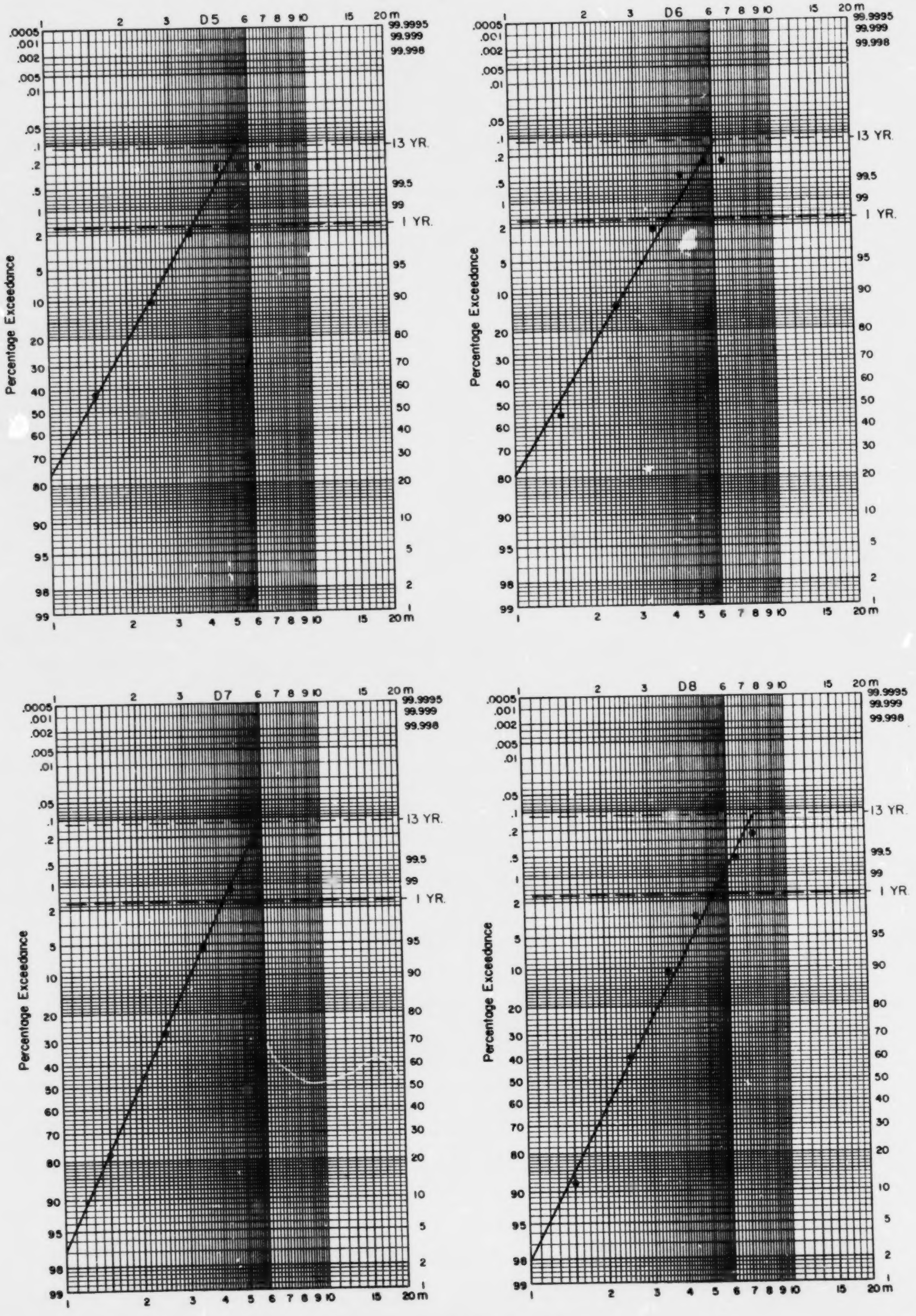


Figure 6k. Monthly Wave Height Exceedance Distribution for June

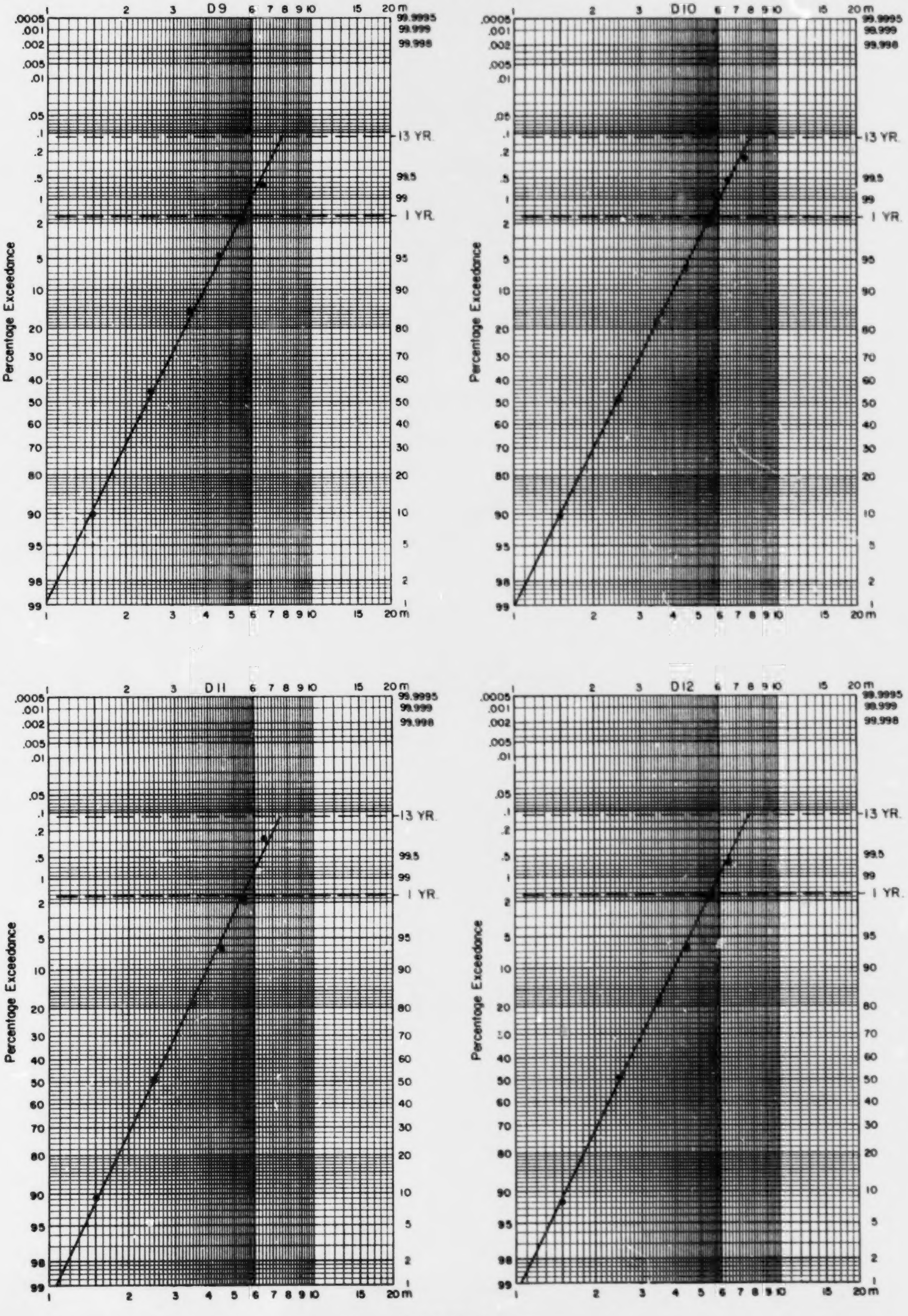


Figure 61. Monthly Wave Height Exceedance Distribution for June

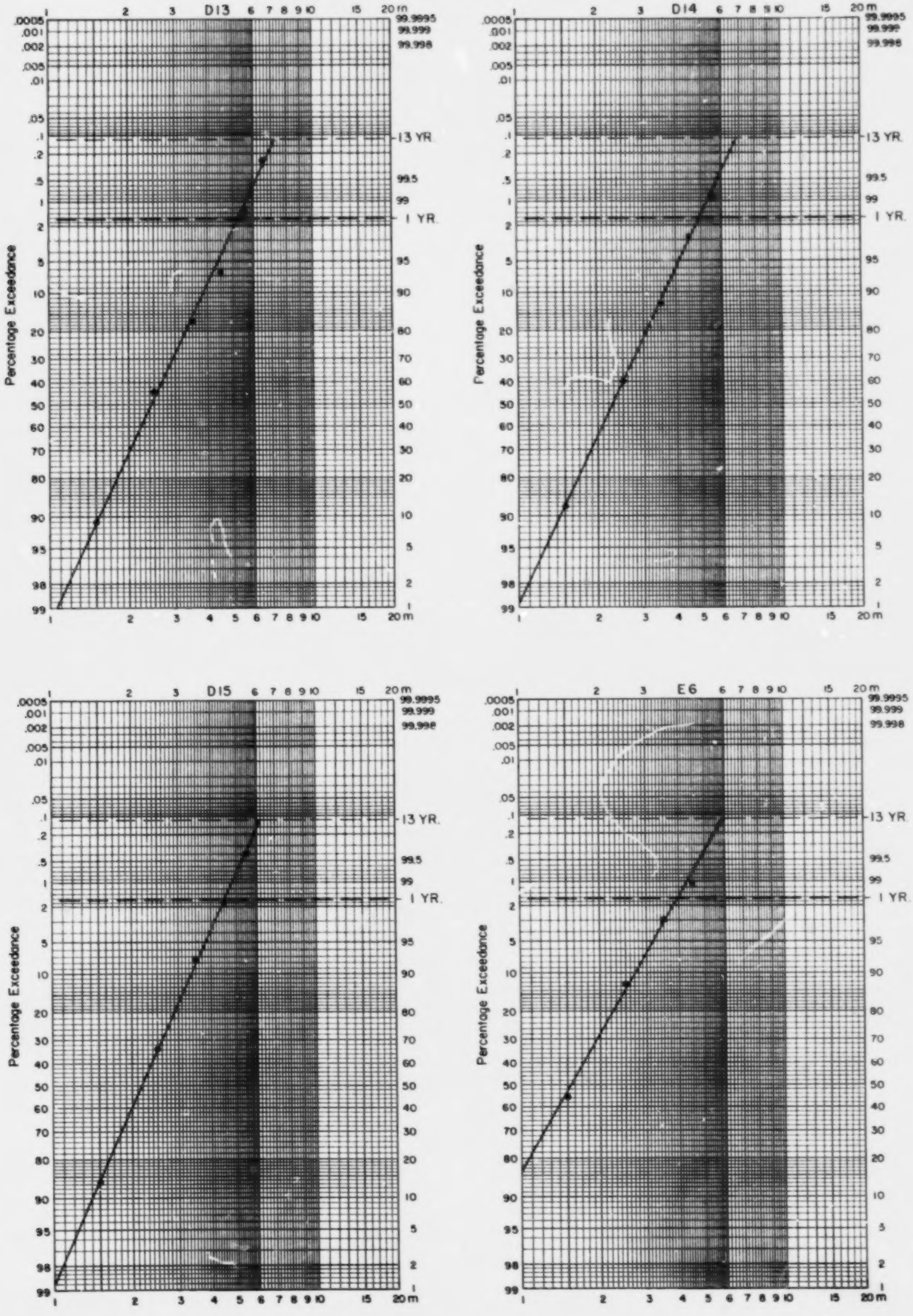


Figure 6m. Monthly Wave Height Exceedance Distribution for June

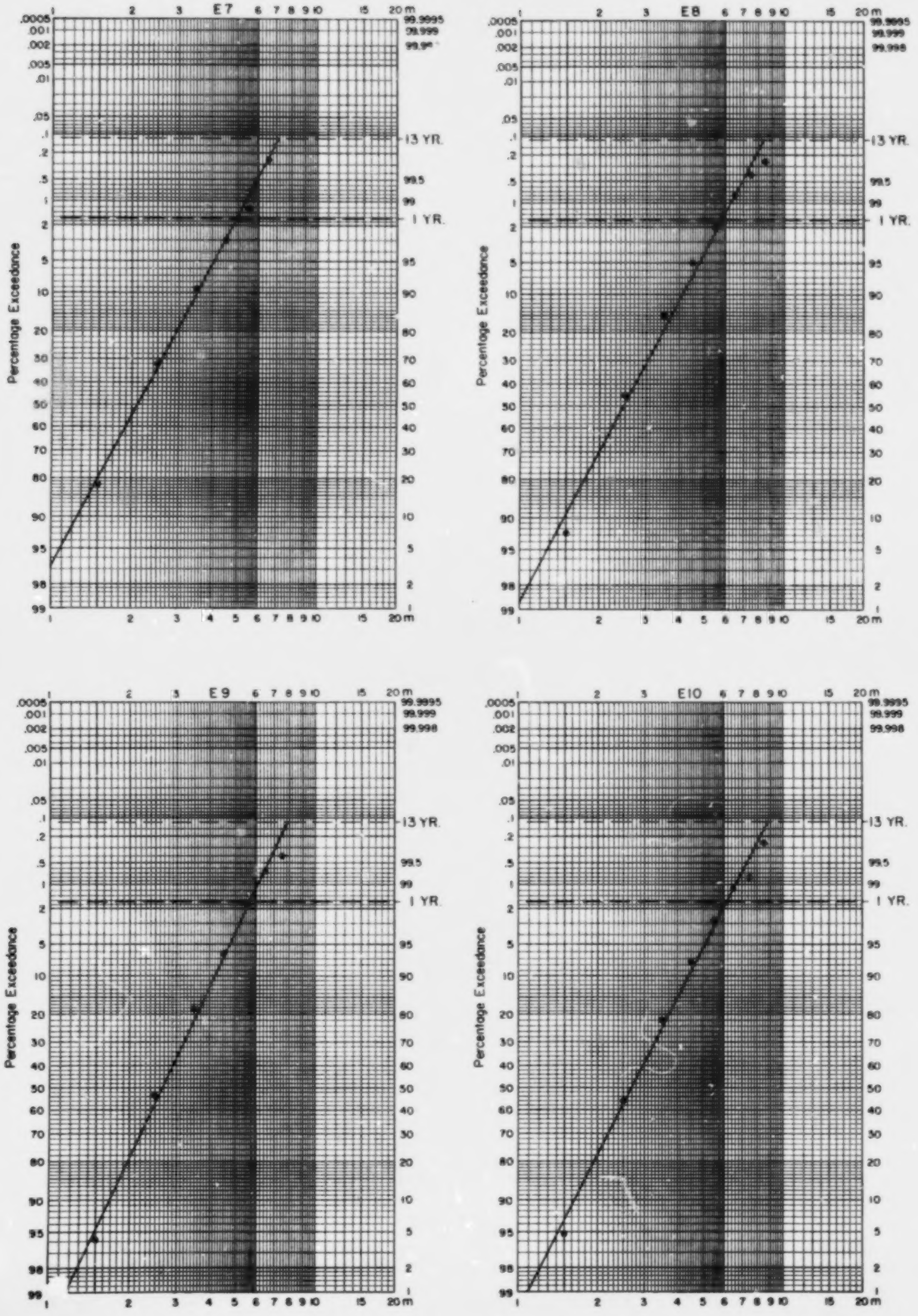


Figure 6n. Monthly Wave Height Exceedance Distribution for June

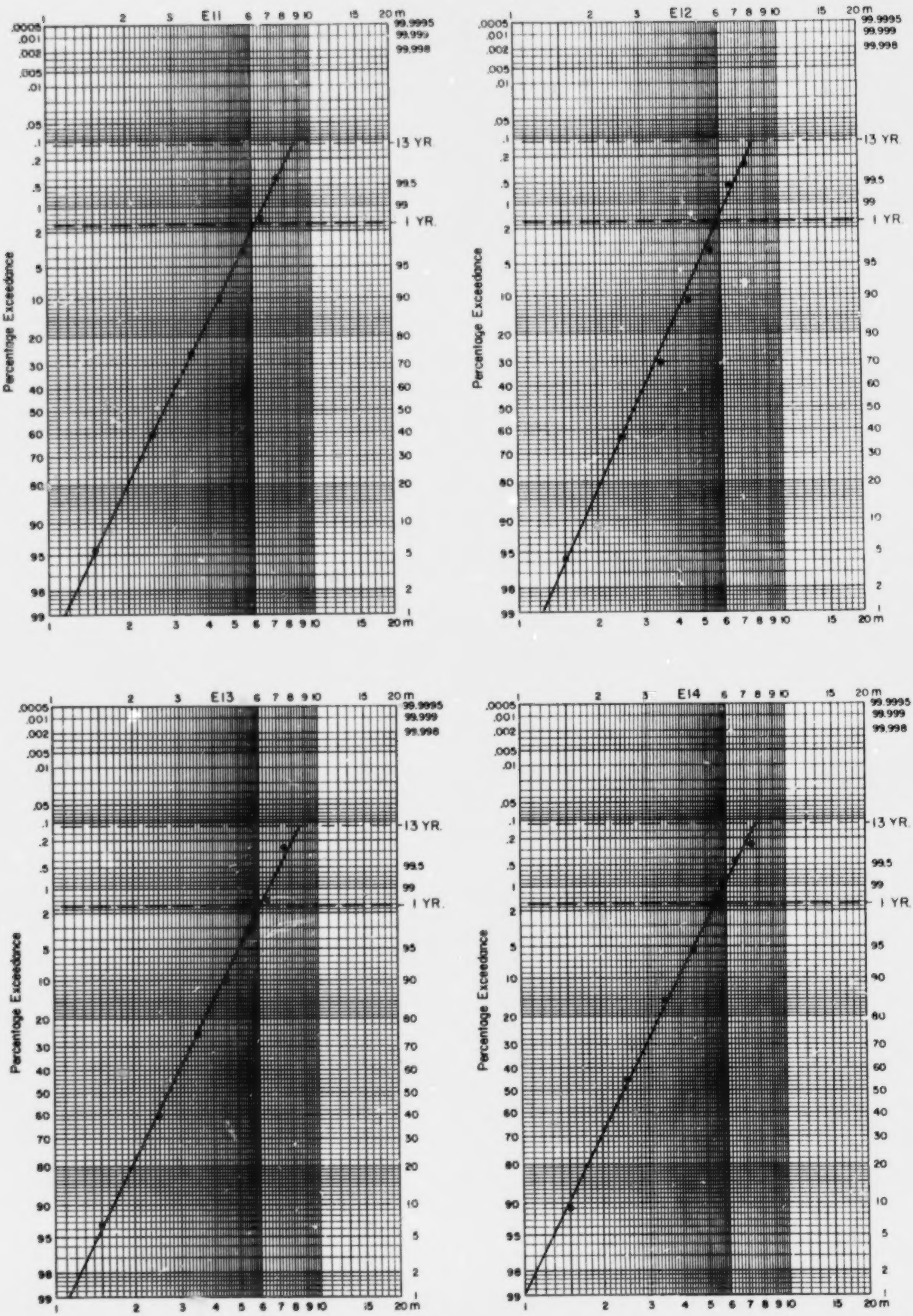


Figure 6o. Monthly Wave Height Exceedance Distribution for June

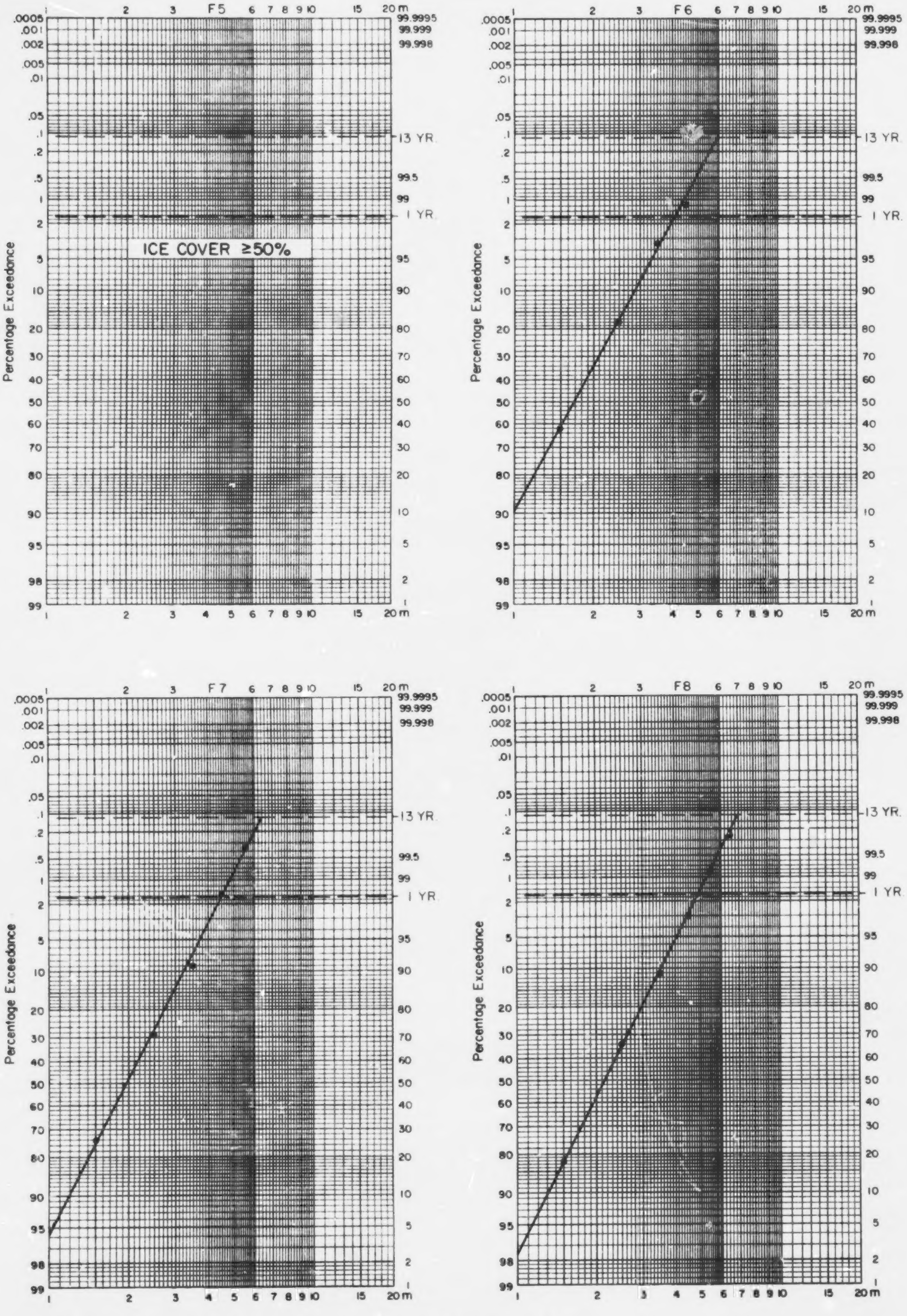
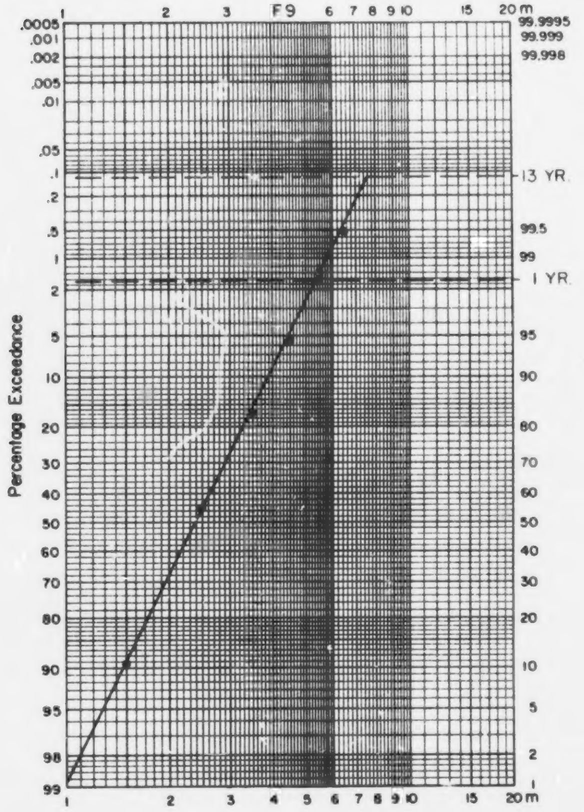
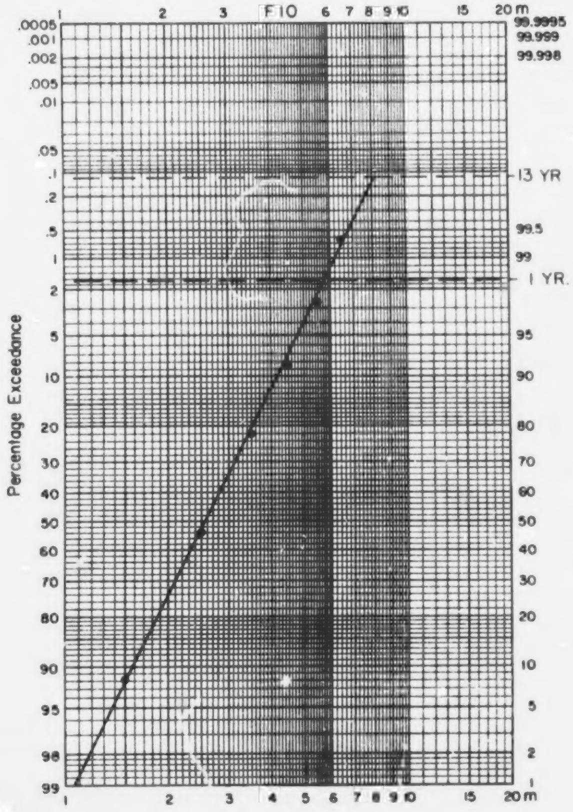
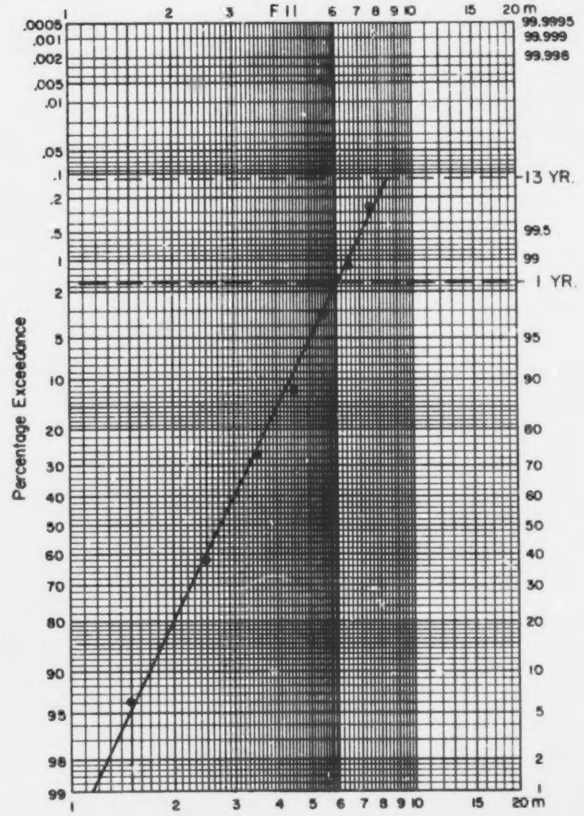


Figure 6p. Monthly Wave Height Exceedance Distribution for June







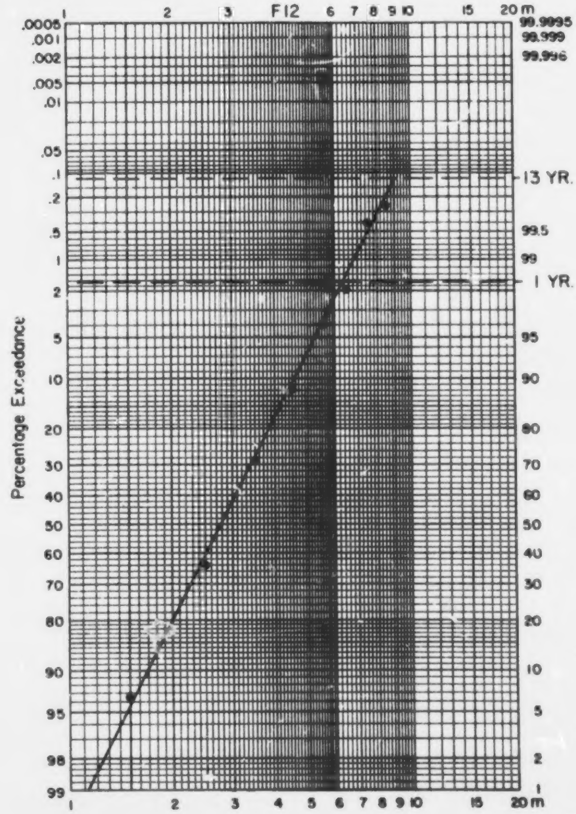


Figure 6q. Monthly Wave Height Exceedance Distribution for June

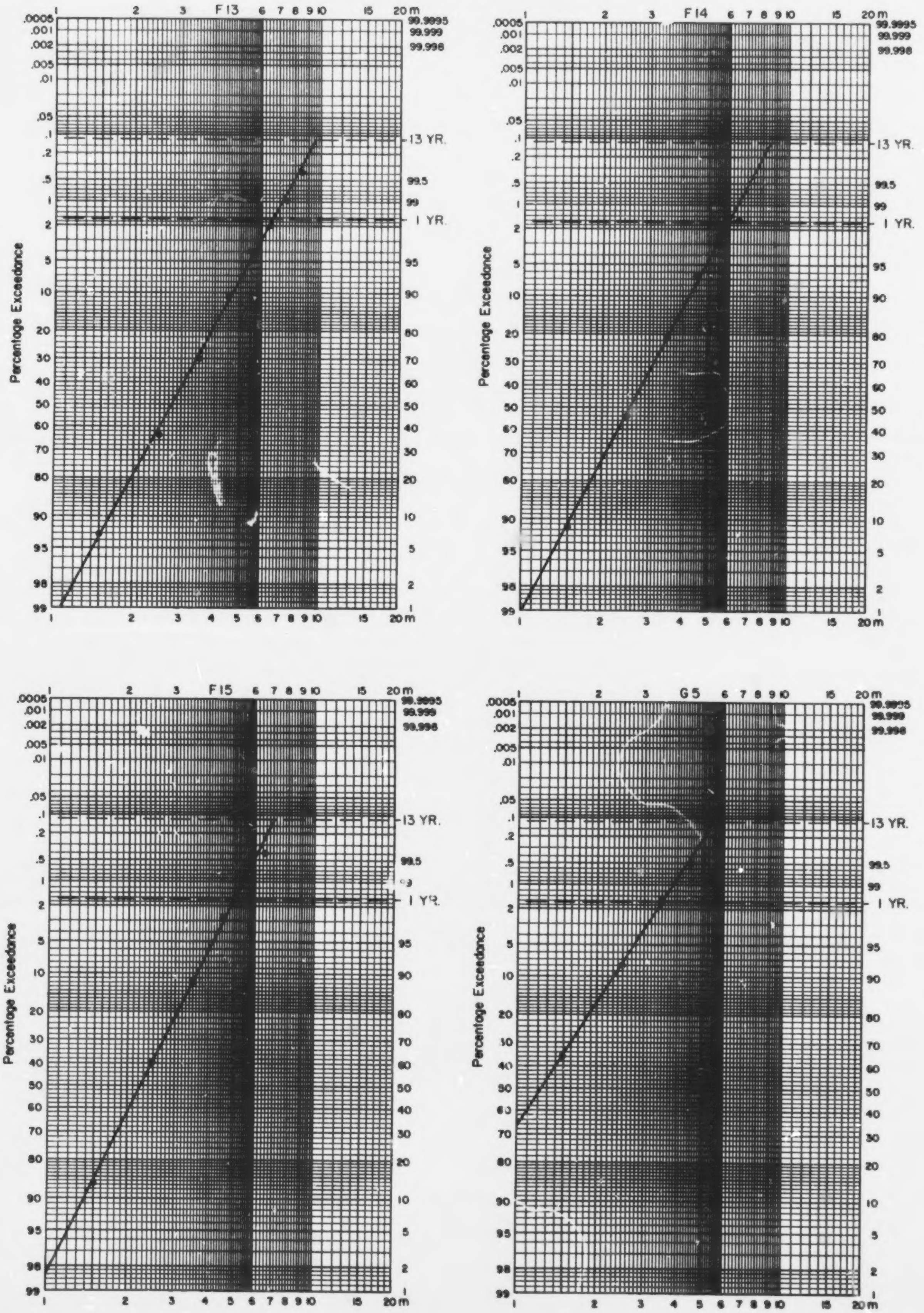


Figure 6r. Monthly Wave Height Exceedance Distribution for June

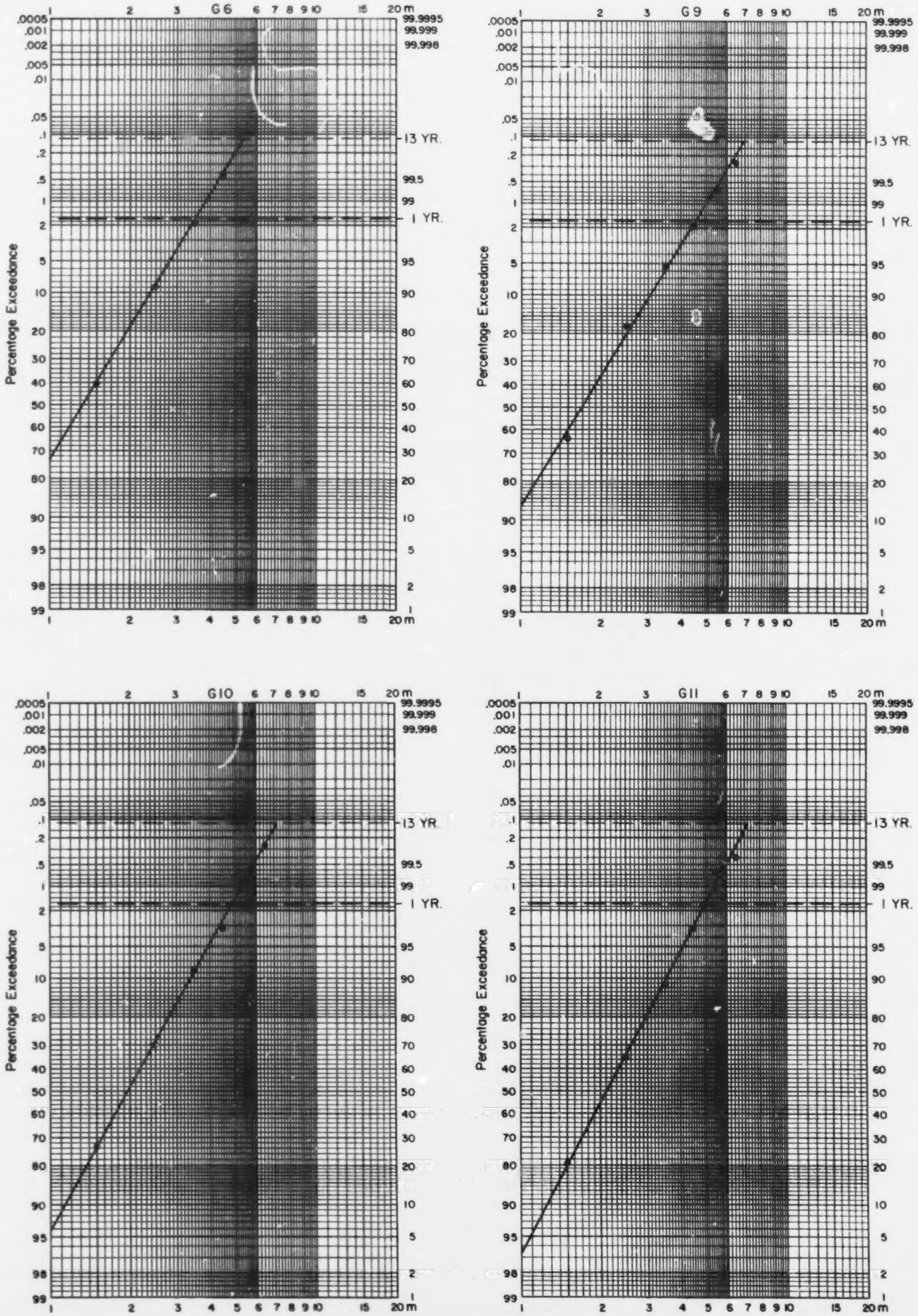


Figure 6s. Monthly Wave Height Exceedance Distribution for June

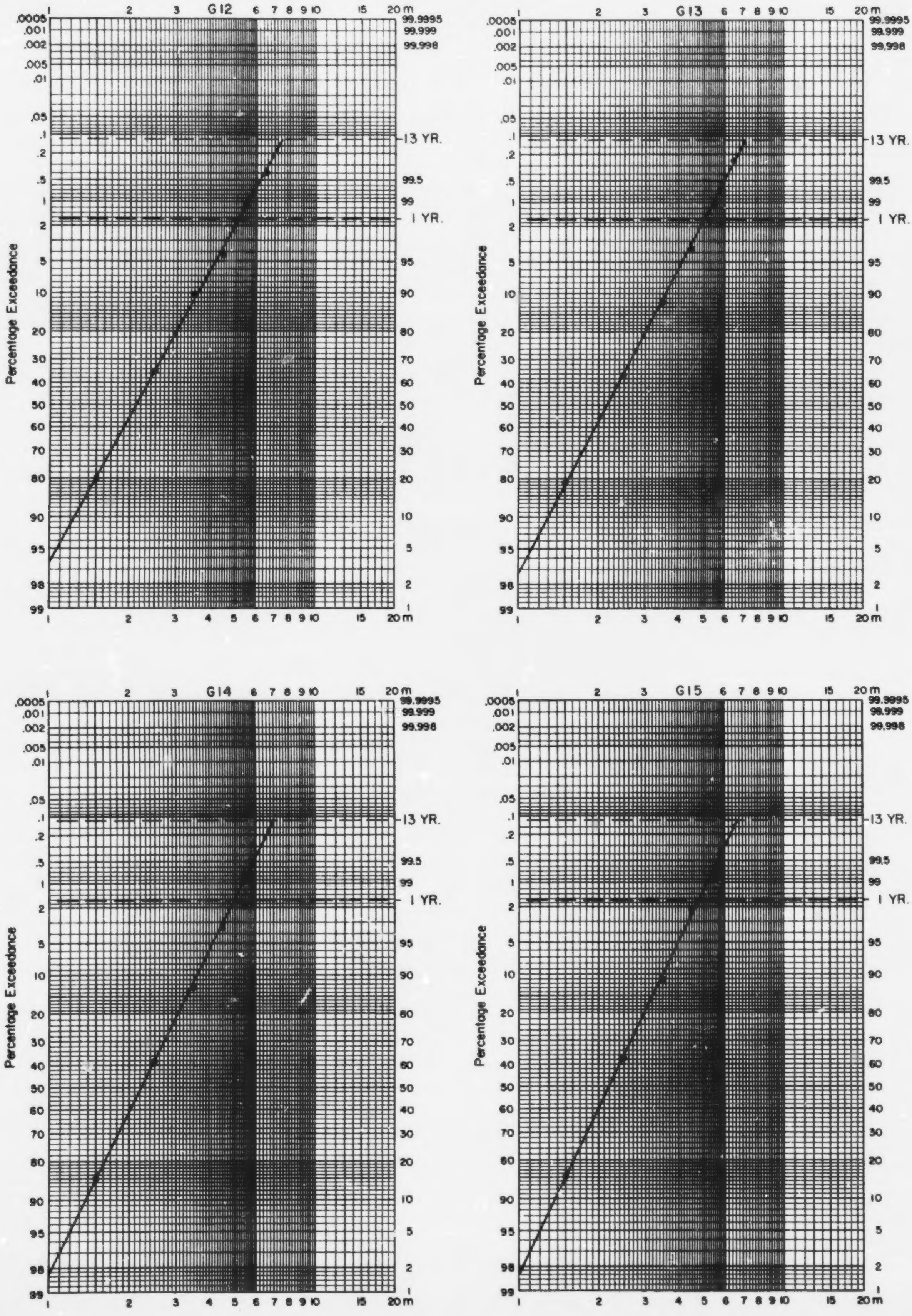
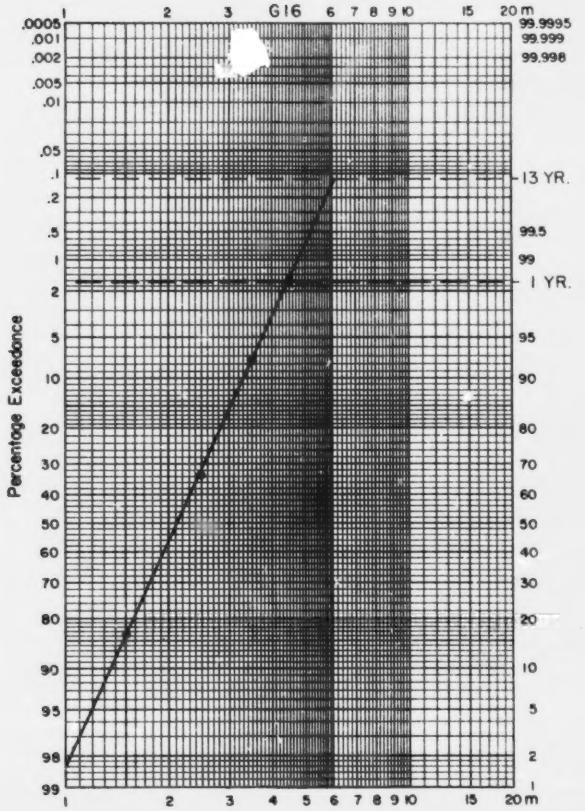
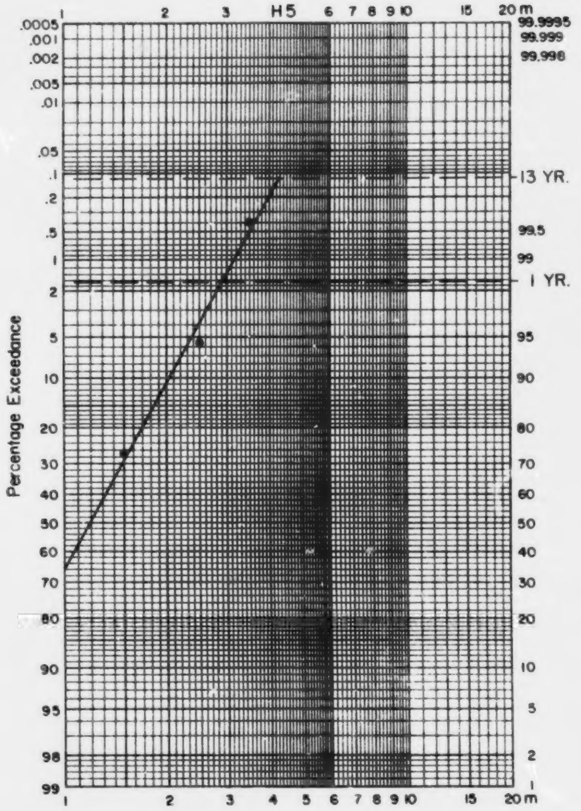
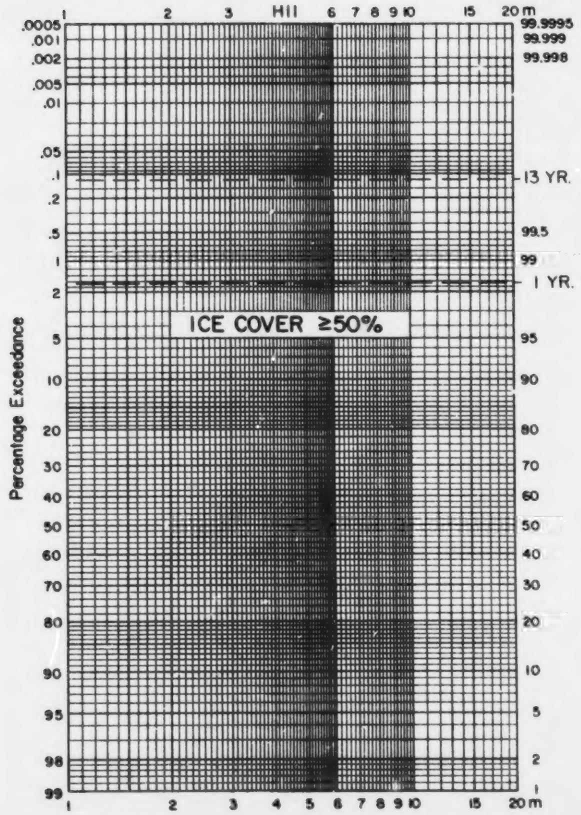


Figure 61. Monthly Wave Height Exceedance Distribution for June







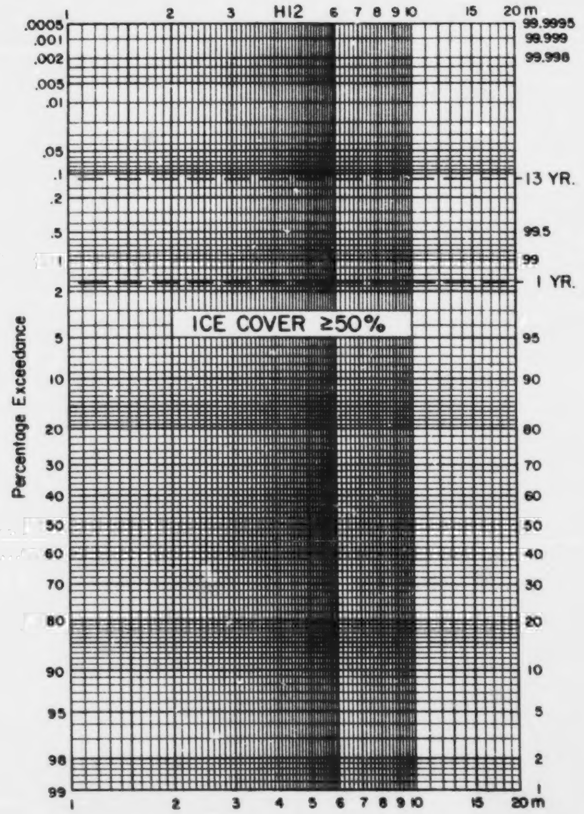


Figure 6u. Monthly Wave Height Exceedance Distribution for June

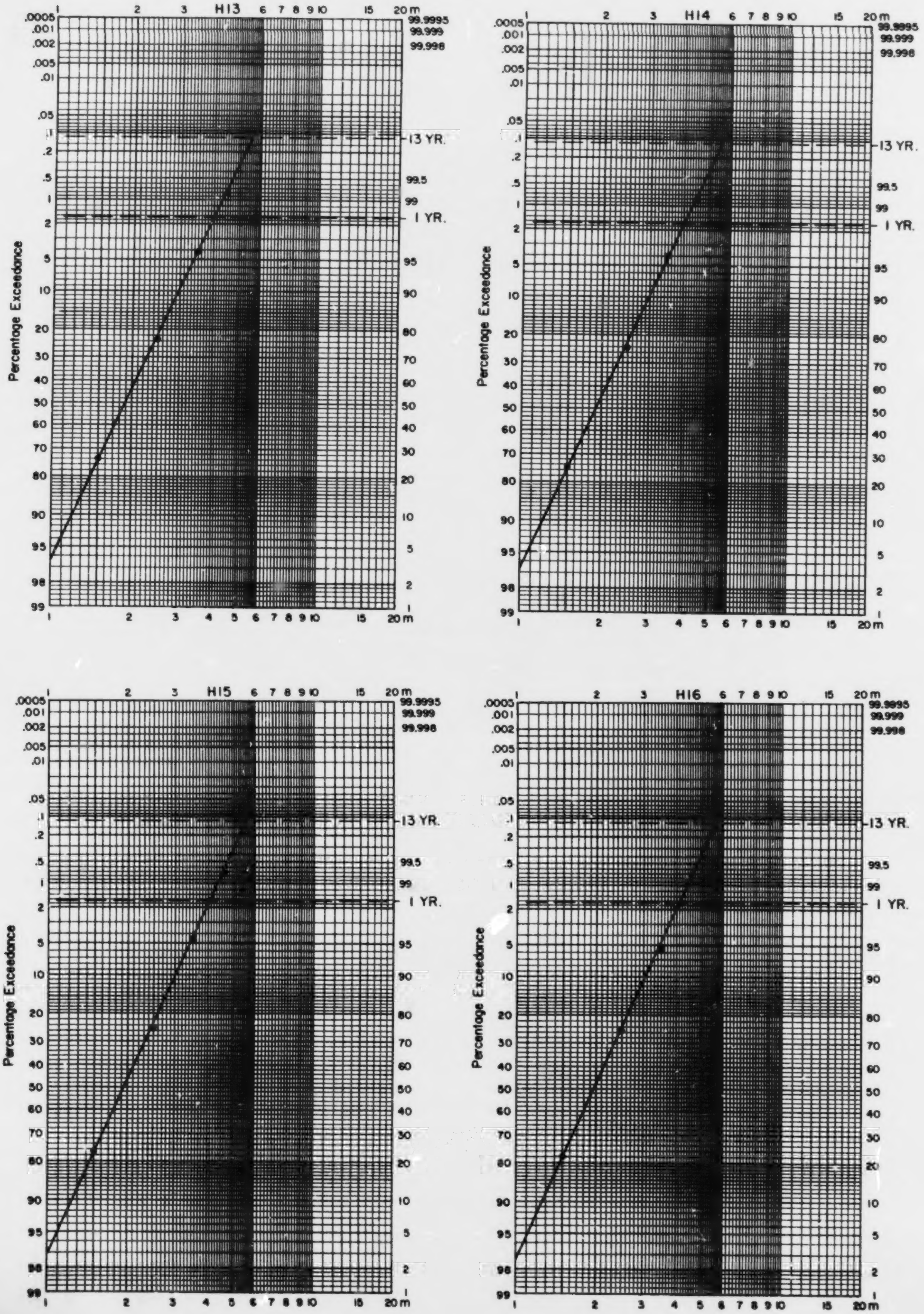


Figure 6v. Monthly Wave Height Exceedance Distribution for June

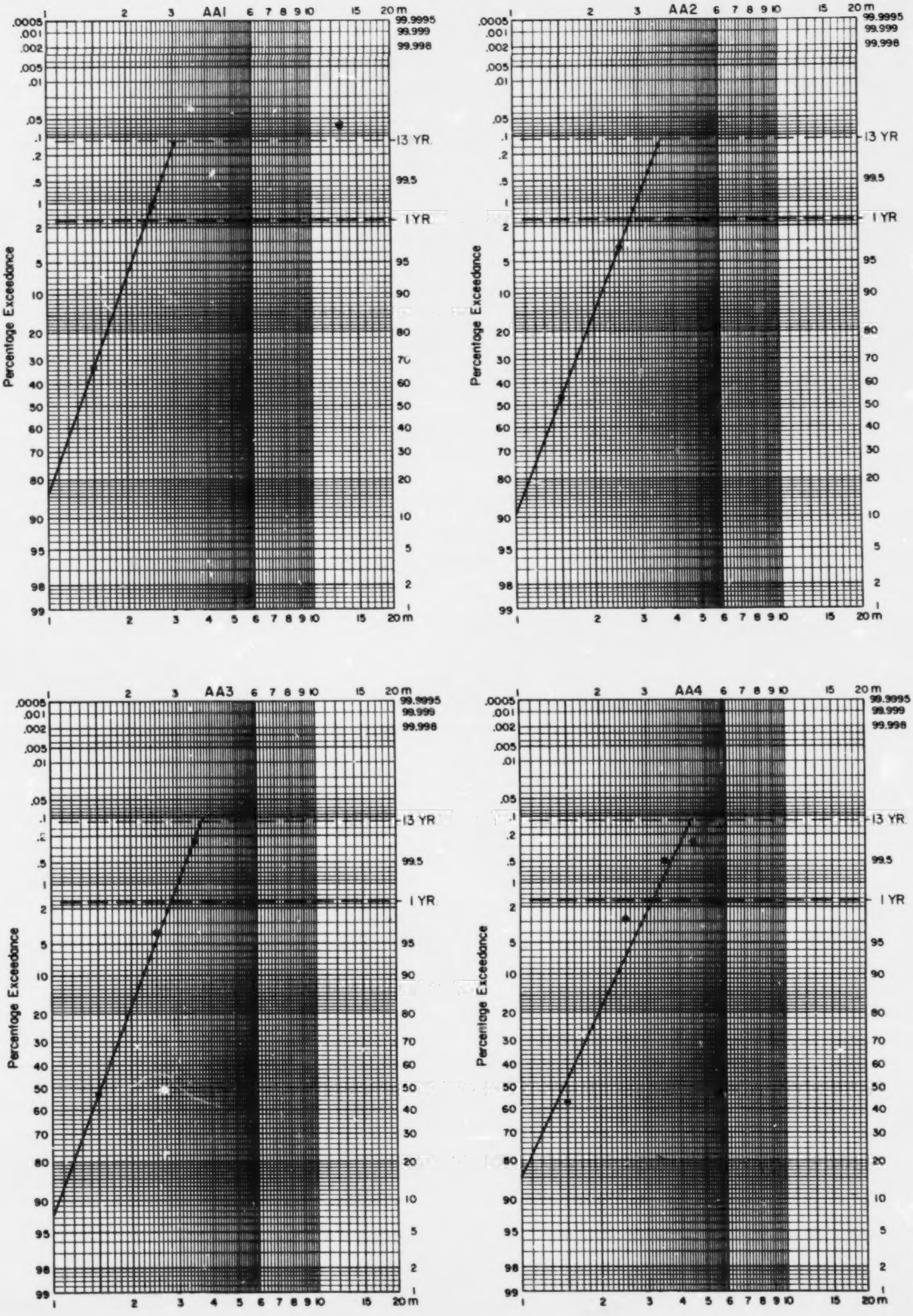


Figure 7a. Monthly Wave Height Exceedance Distribution for July

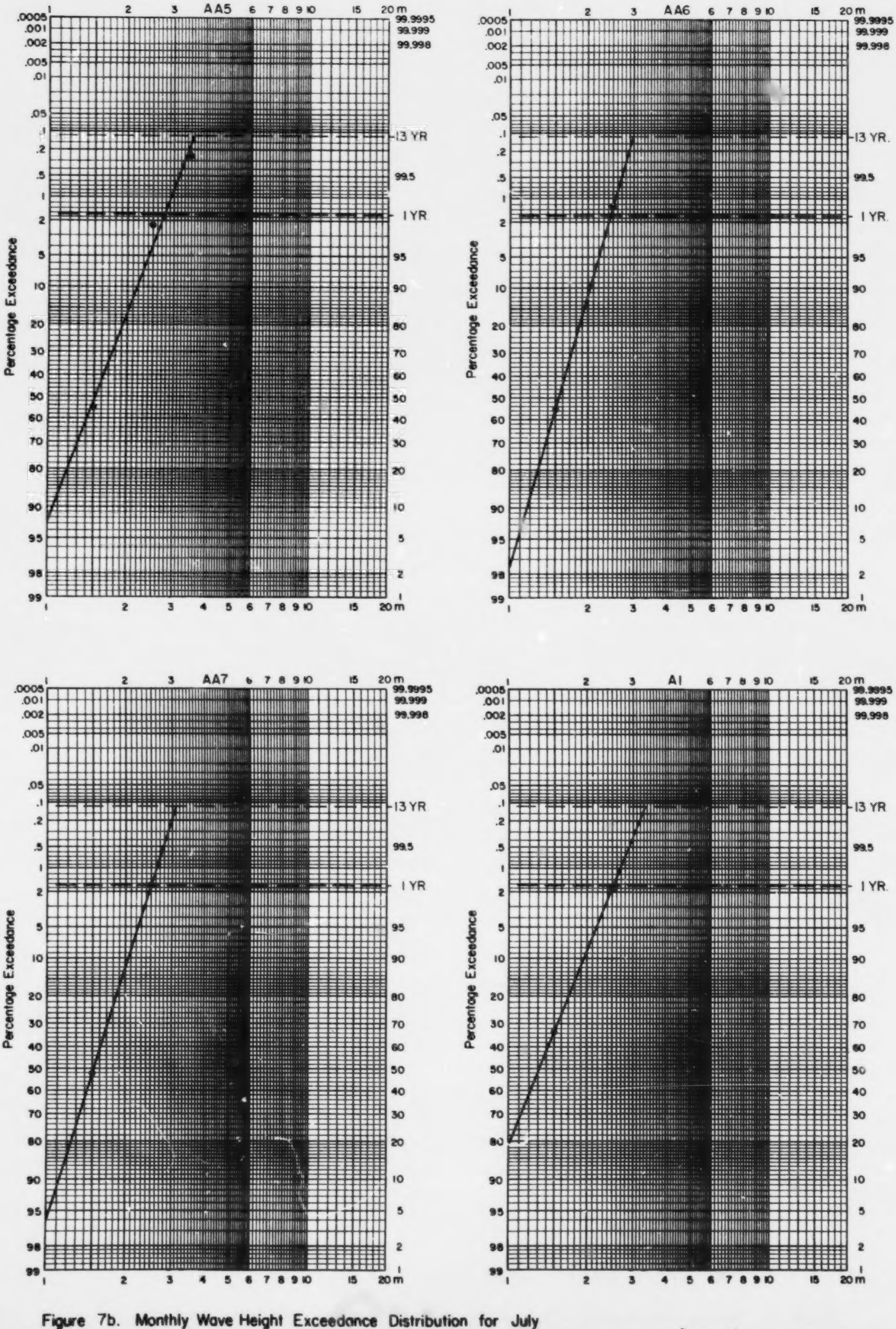


Figure 7b. Monthly Wave Height Exceedance Distribution for July

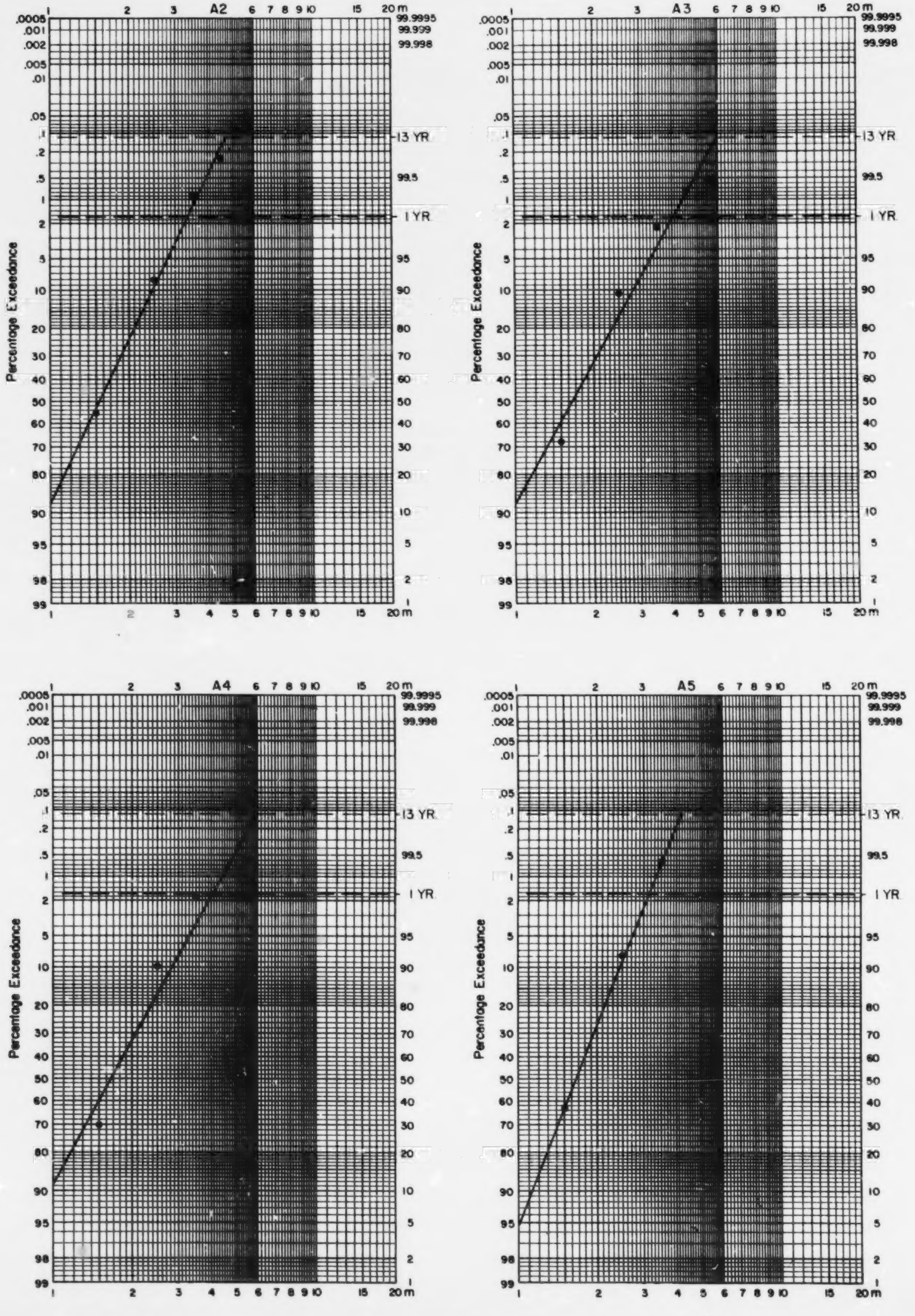


Figure 7c. Monthly Wave Height Exceedance Distribution for July

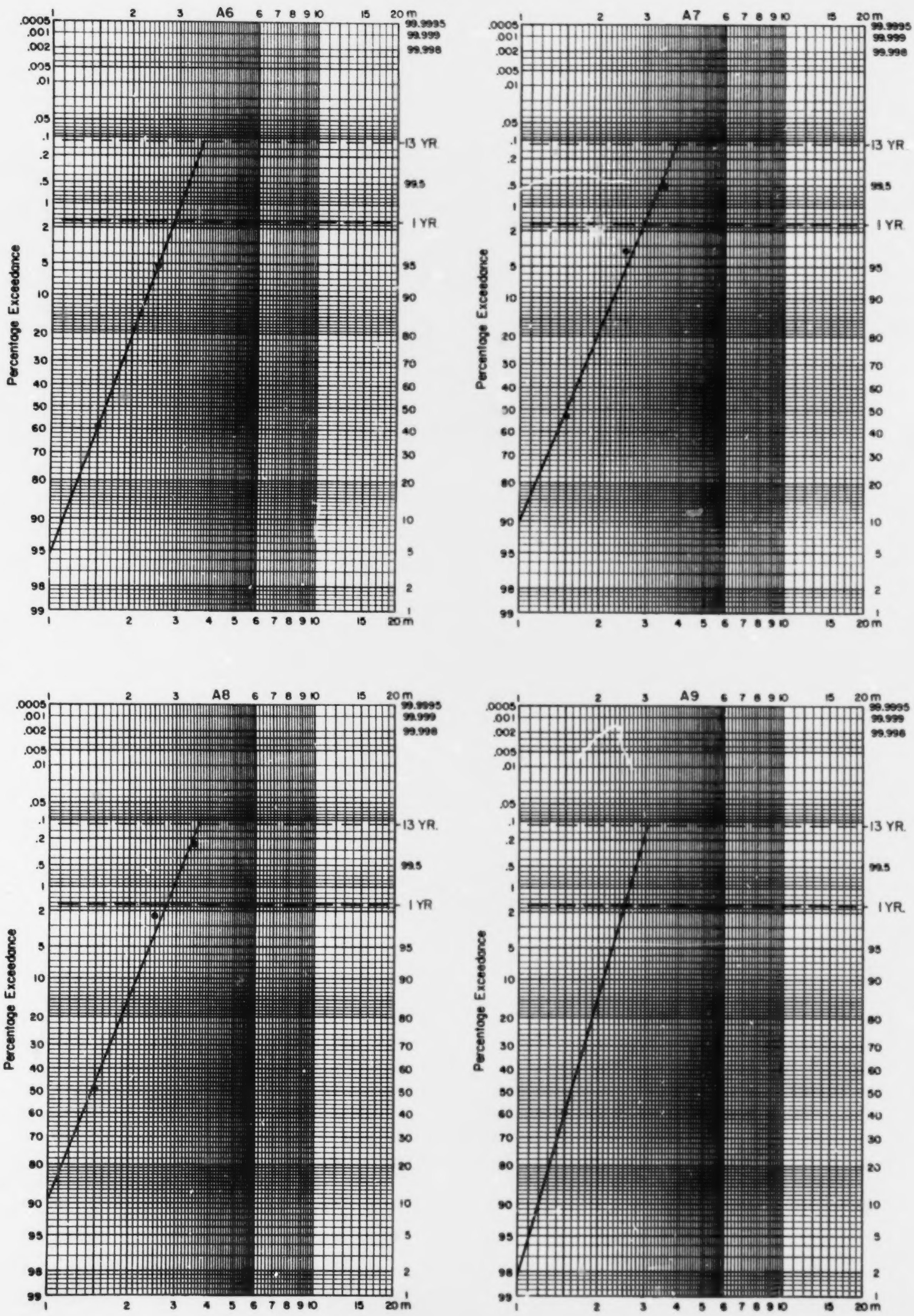
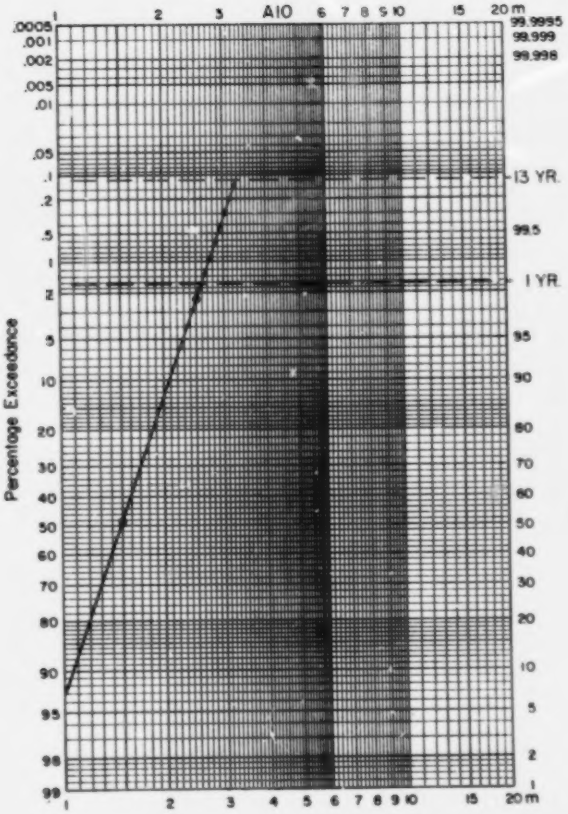
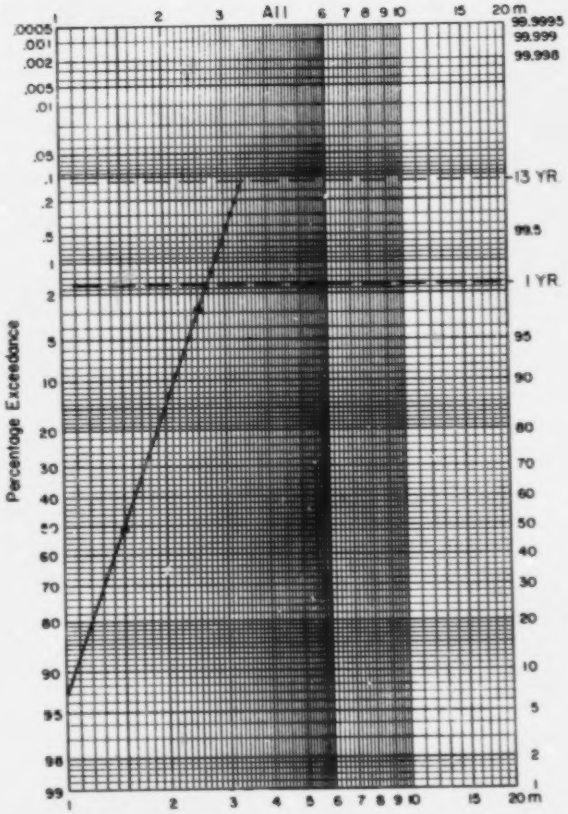
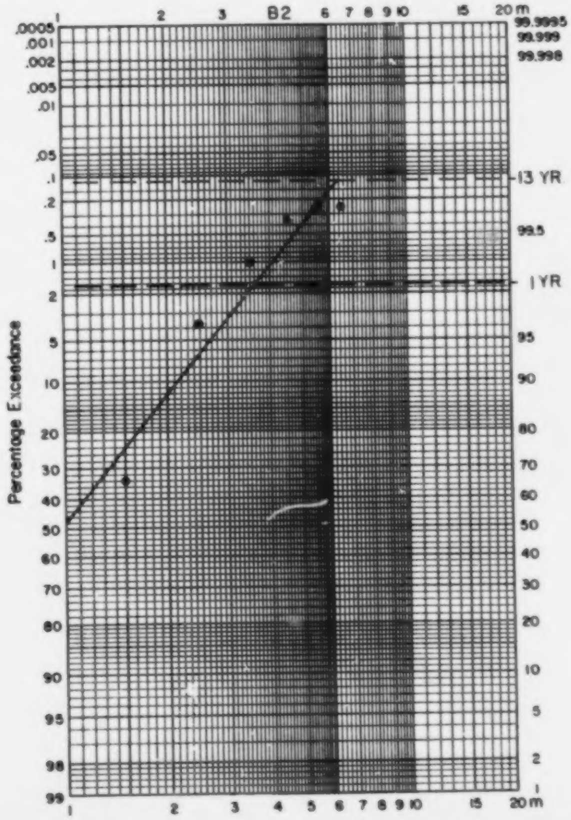


Figure 7d. Monthly Wave Height Exceedance Distribution for July







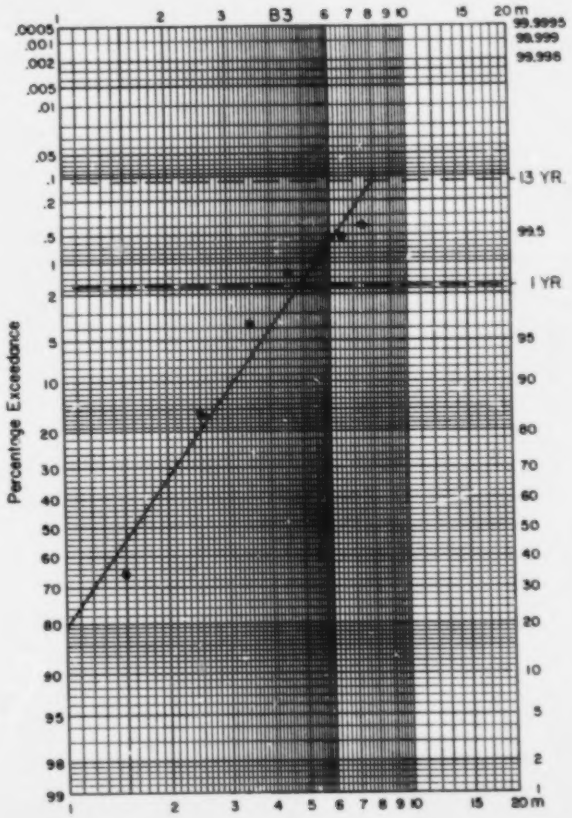


Figure 7e. Monthly Wave Height Exceedance Distribution for July

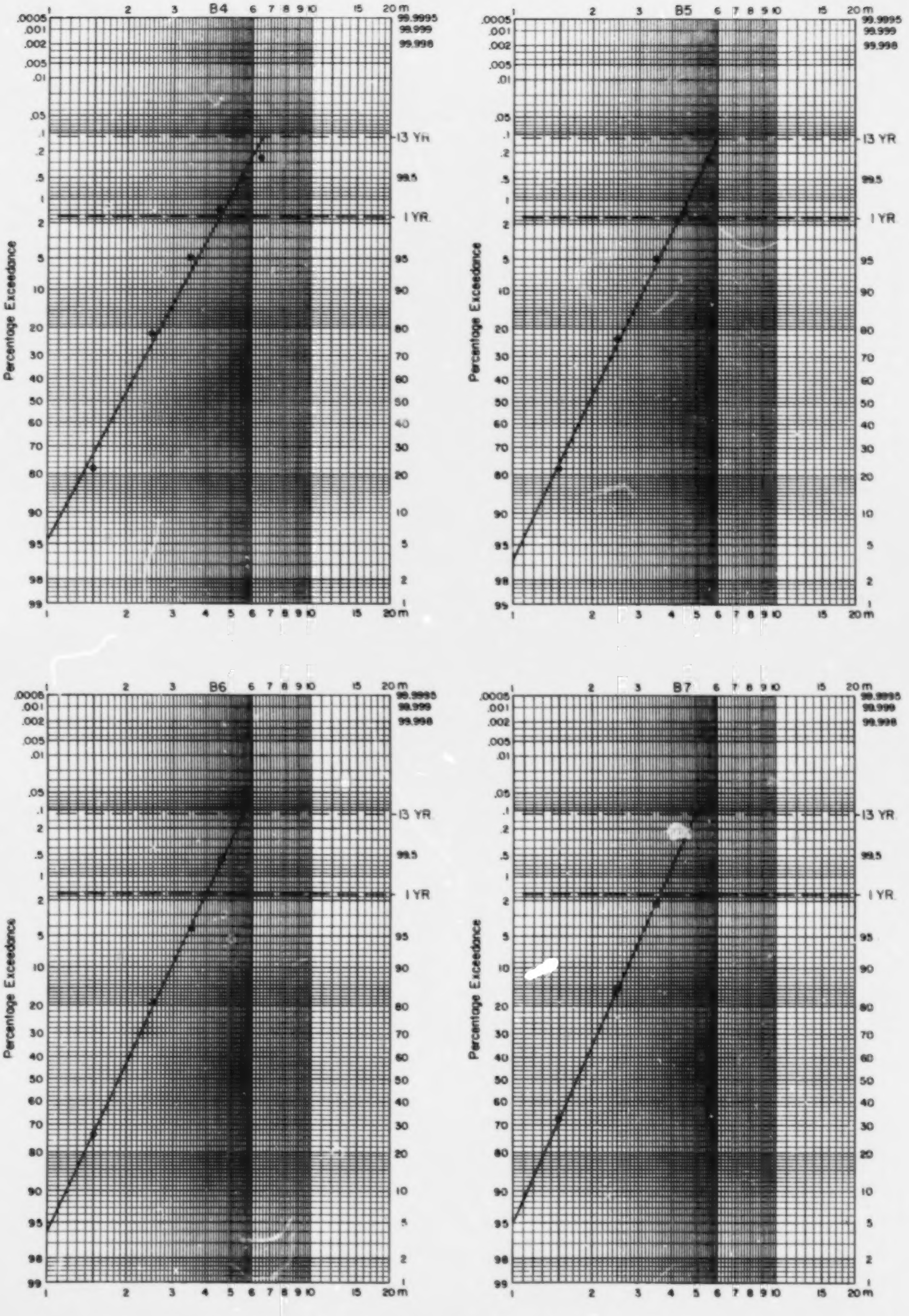


Figure 7f. Monthly Wave Height Exceedance Distribution for July

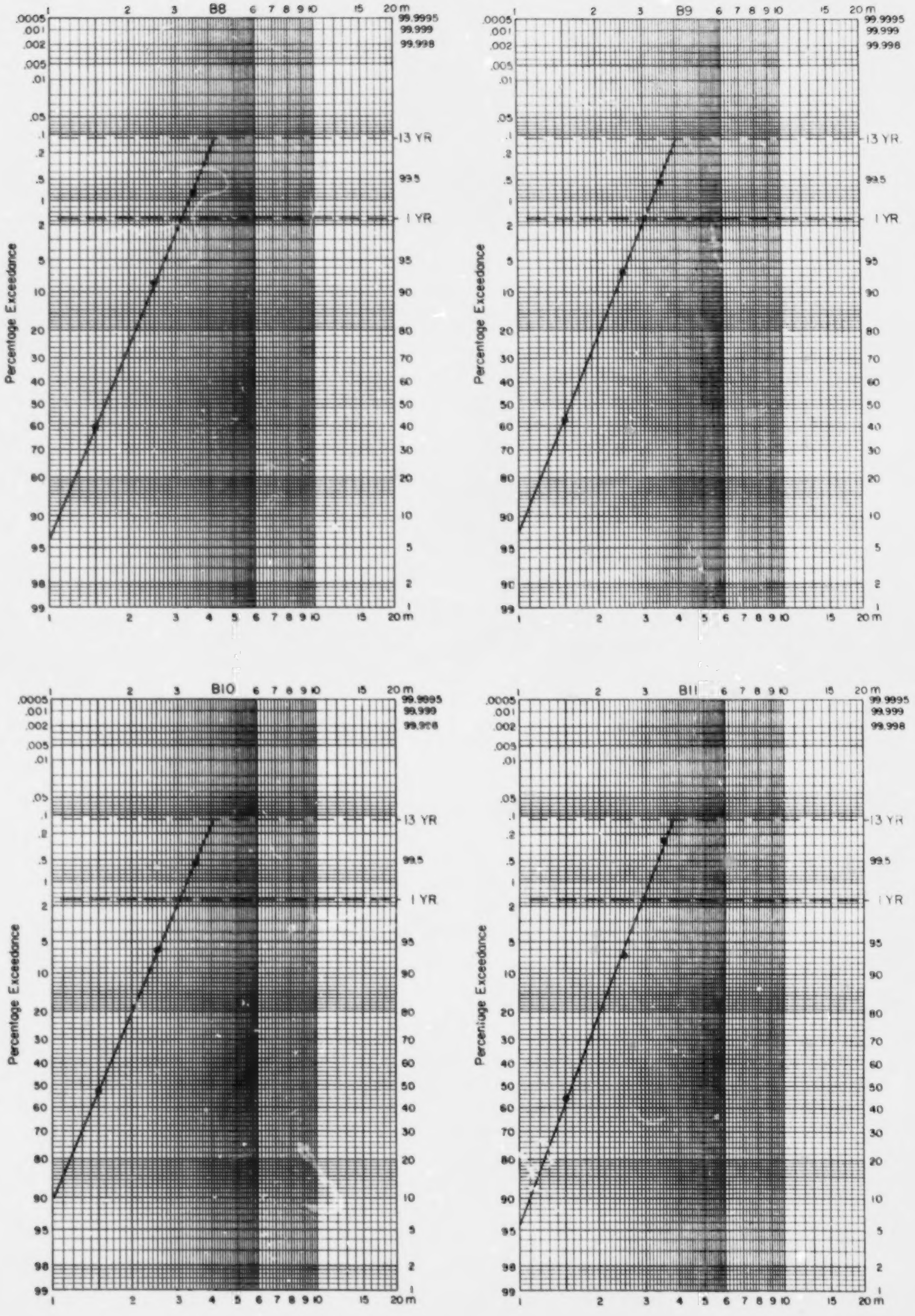


Figure 7g. Monthly Wave Height Exceedance Distribution for July

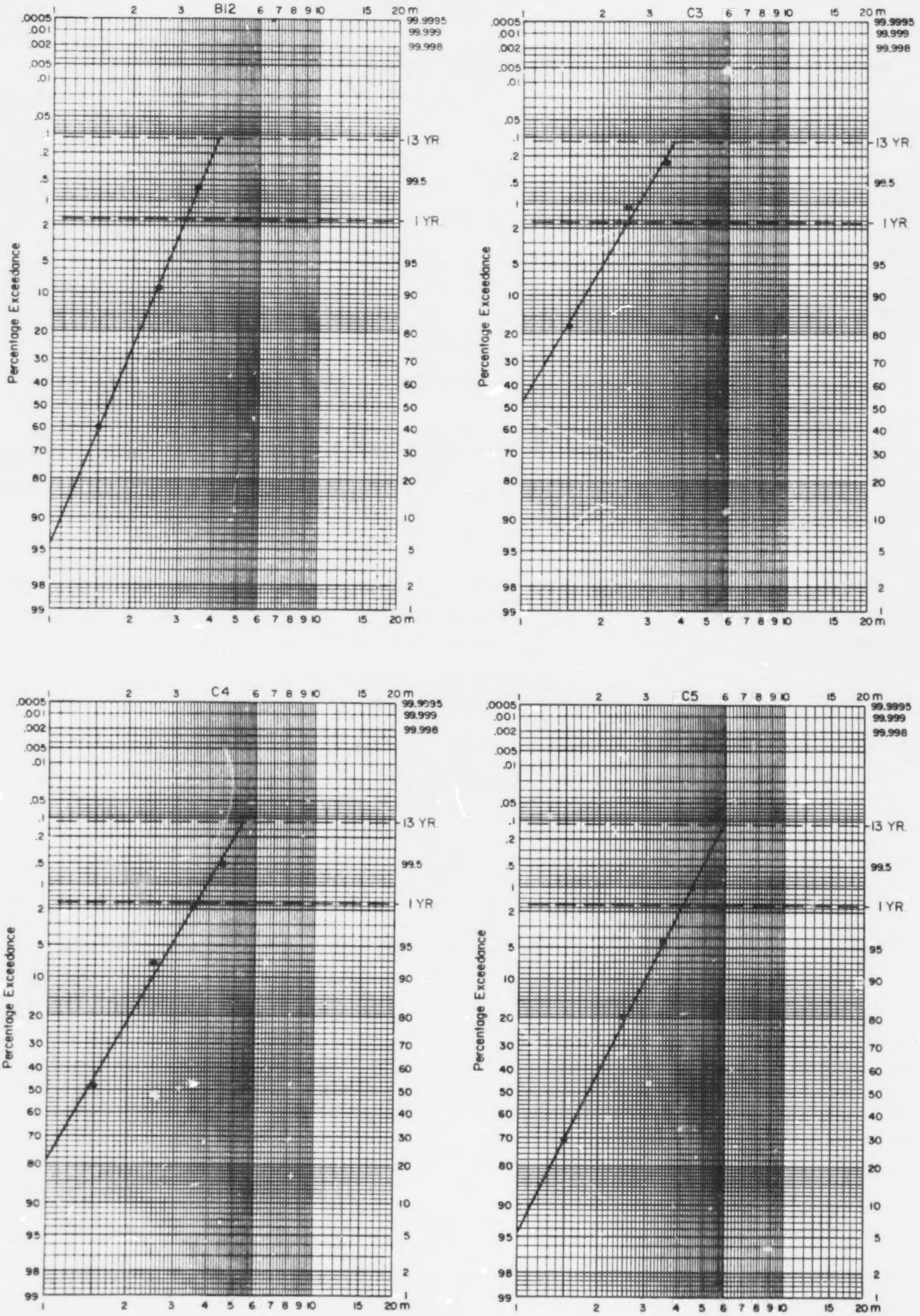


Figure 7h. Monthly Wave Height Exceedance Distribution for July

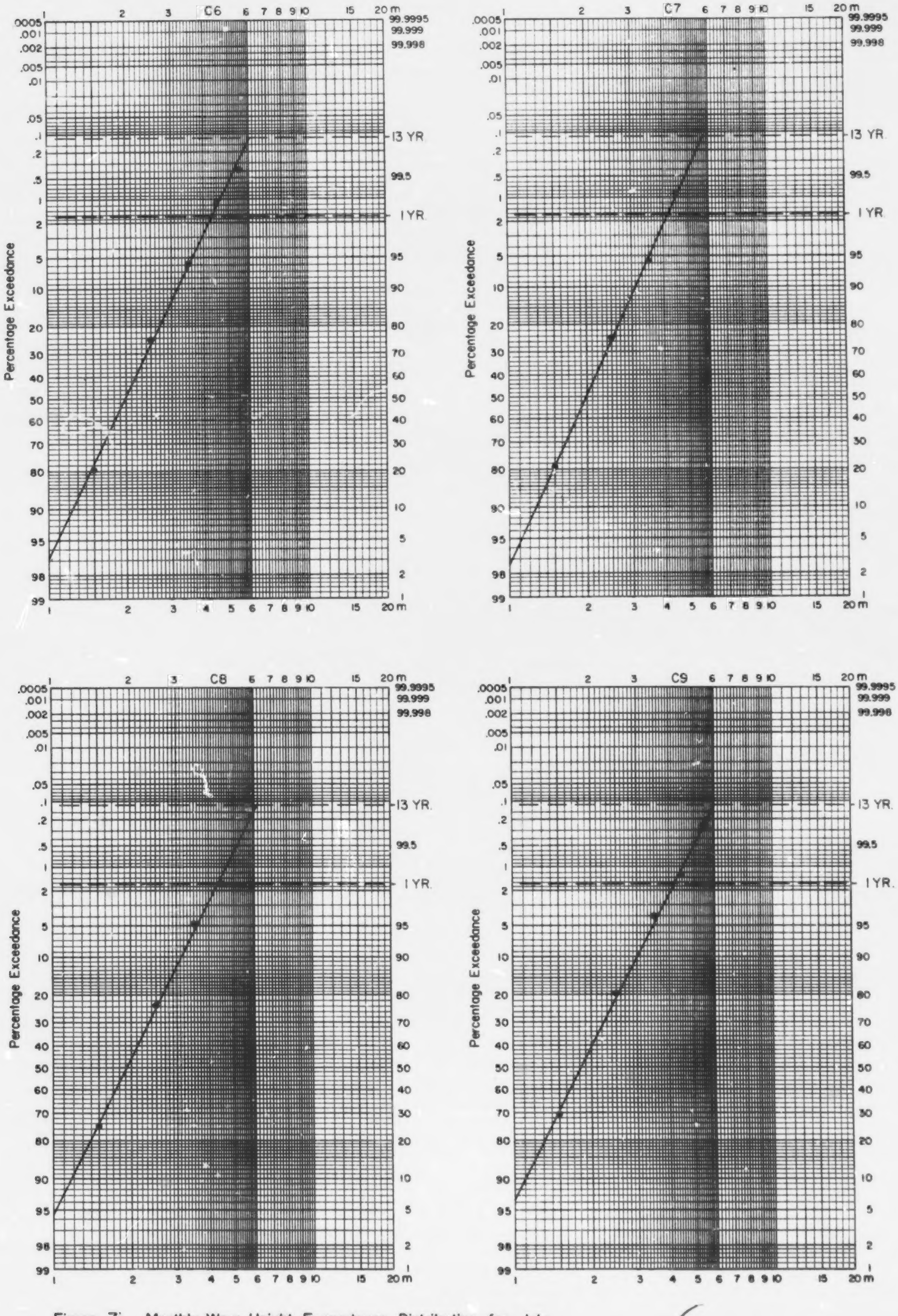


Figure 7i. Monthly Wave Height Exceedance Distribution for July

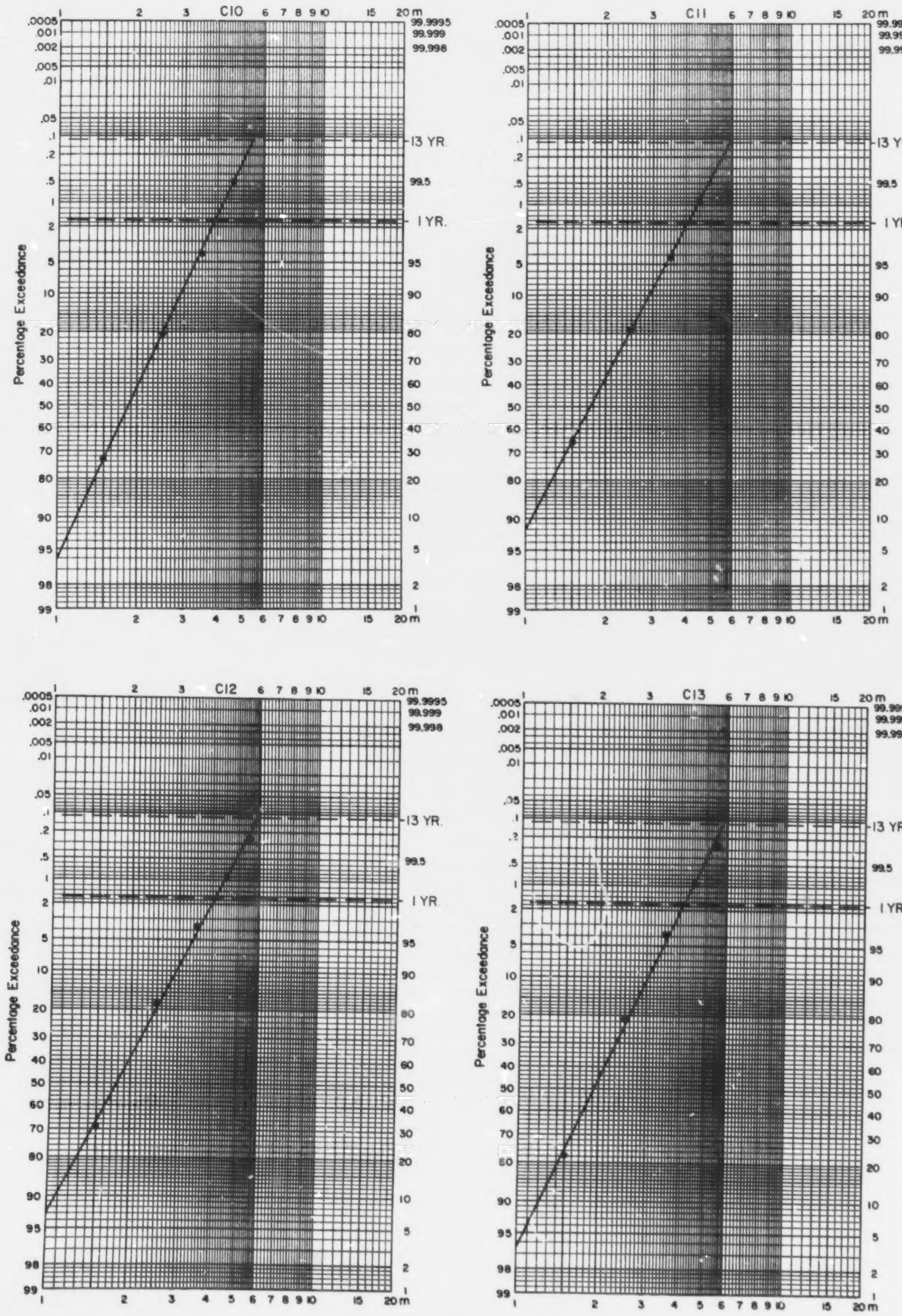


Figure 7j. Monthly Wave Height Exceedance Distribution for July

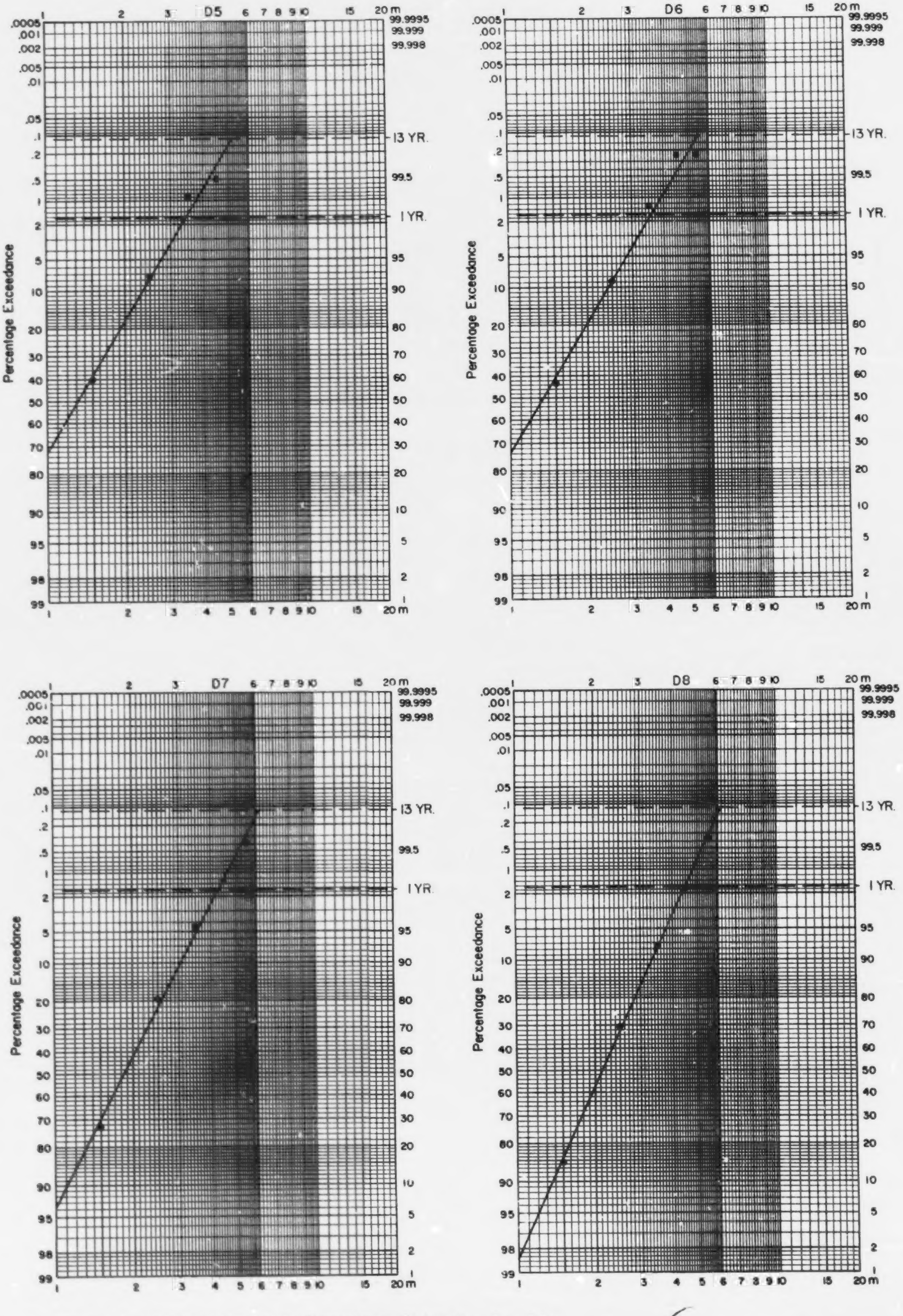


Figure 7k. Monthly Wave Height Exceedance Distribution for July

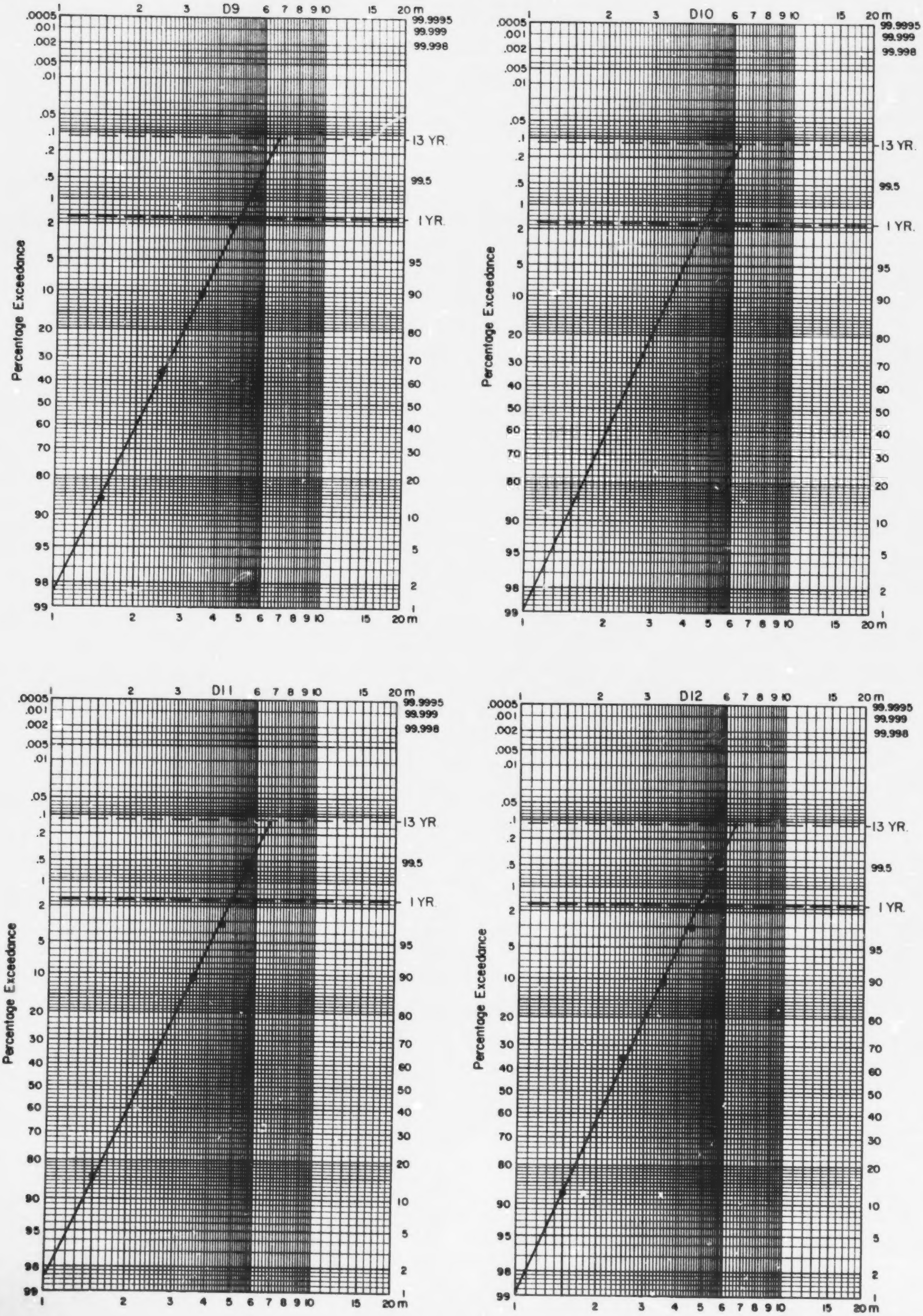


Figure 71. Monthly Wave Height Exceedance Distribution for July

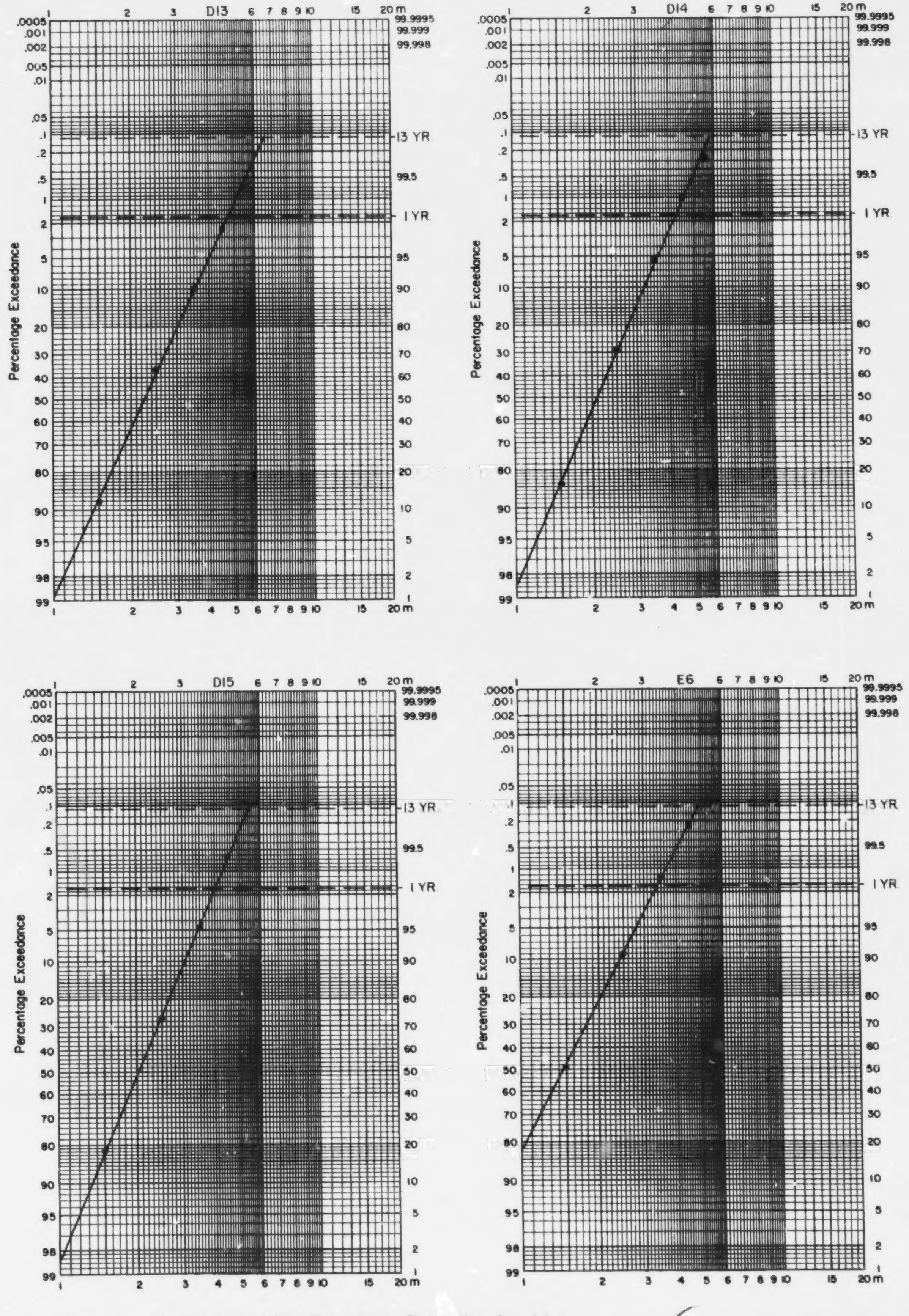


Figure 7m. Monthly Wave Height Exceedance Distribution for July

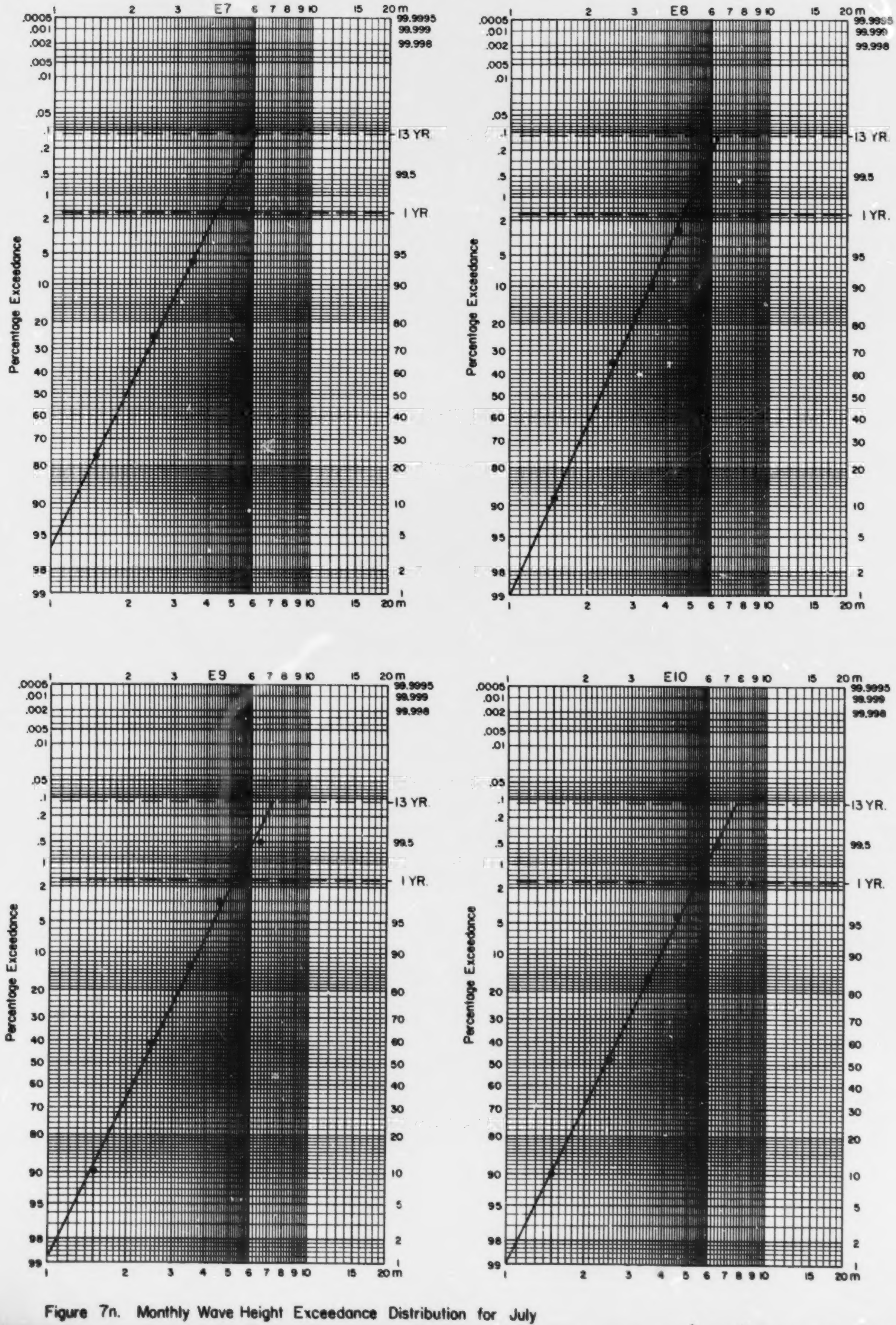


Figure 7n. Monthly Wave Height Exceedance Distribution for July

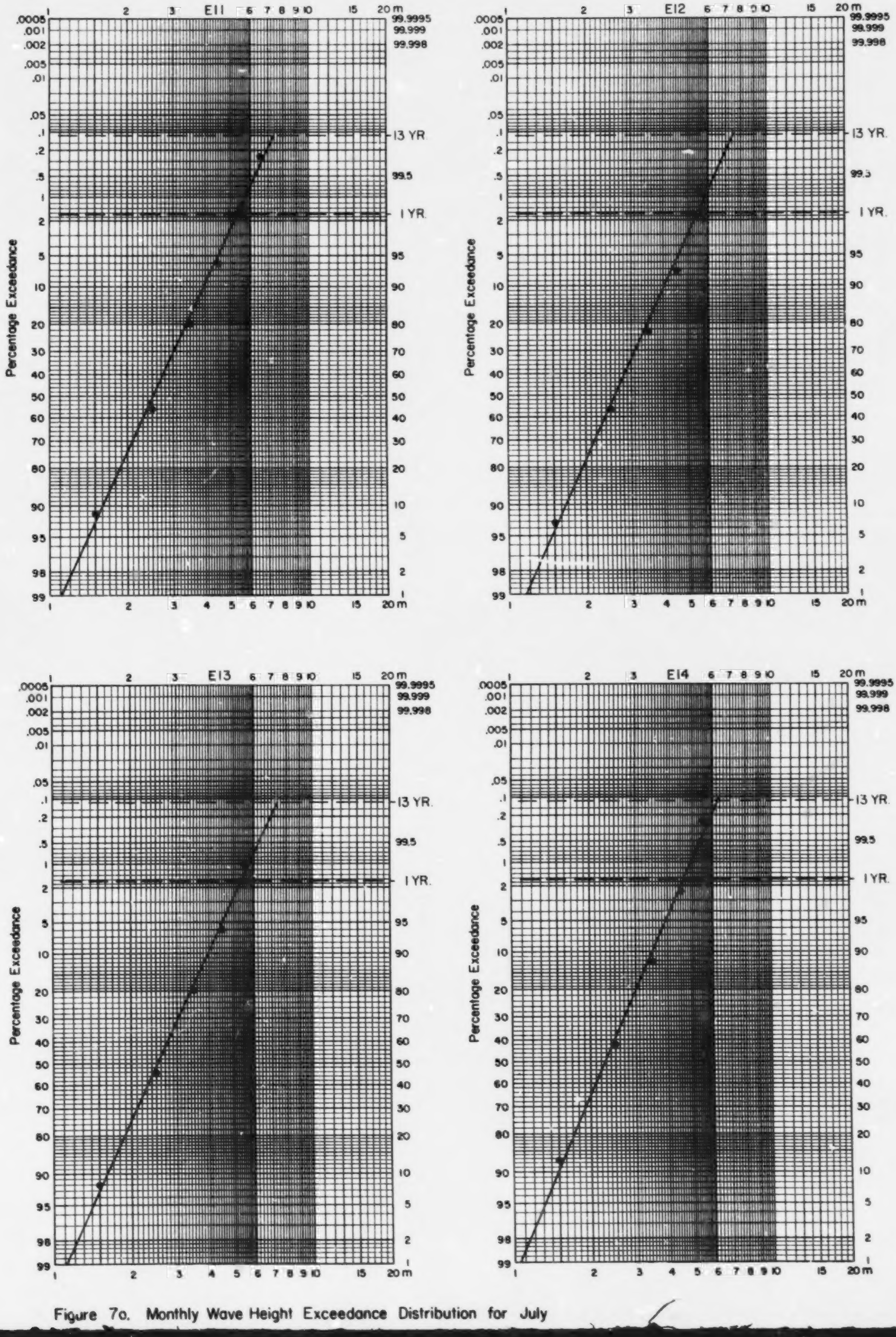


Figure 7o. Monthly Wave Height Exceedance Distribution for July

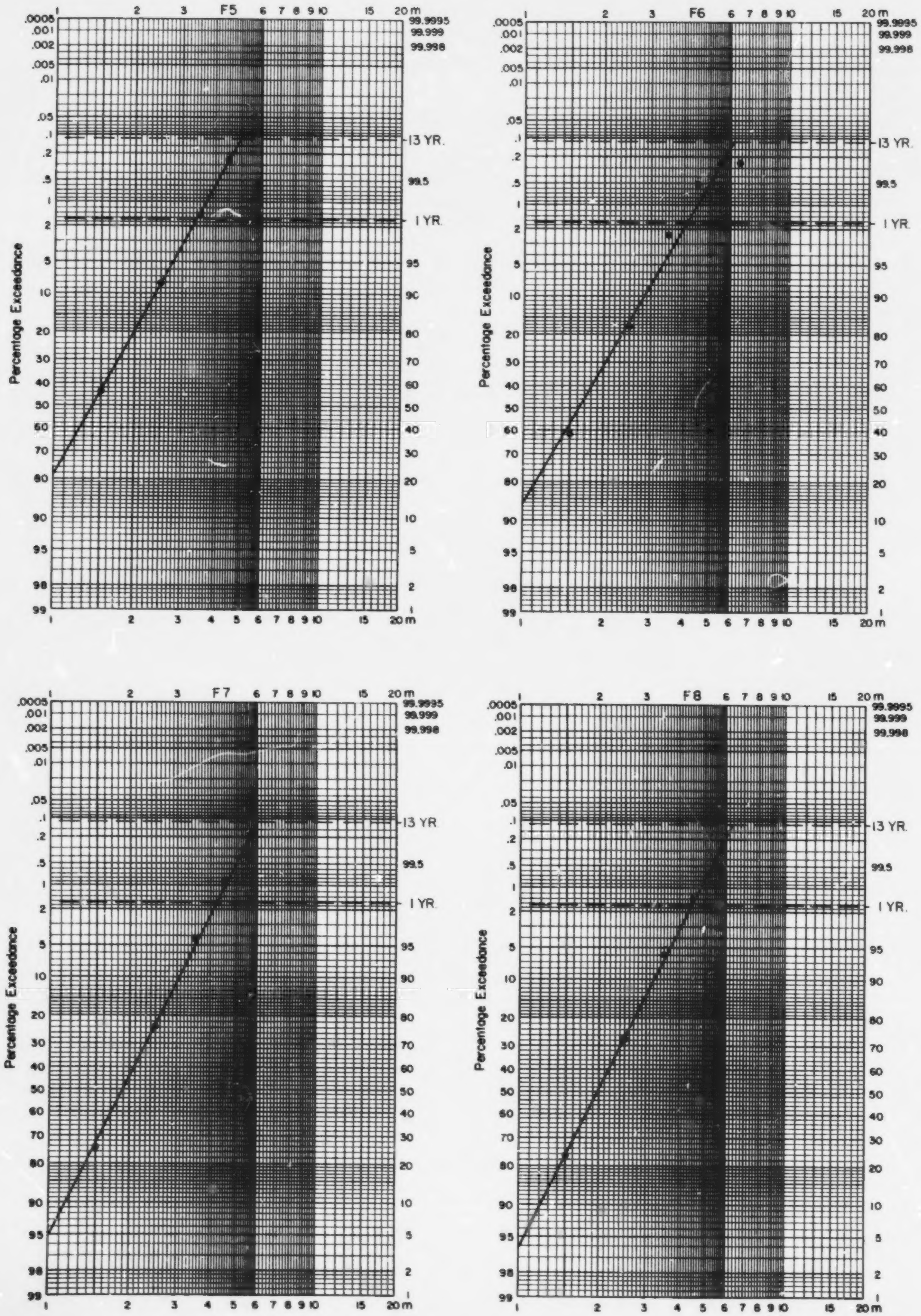


Figure 7p. Monthly Wave Height Exceedance Distribution for July

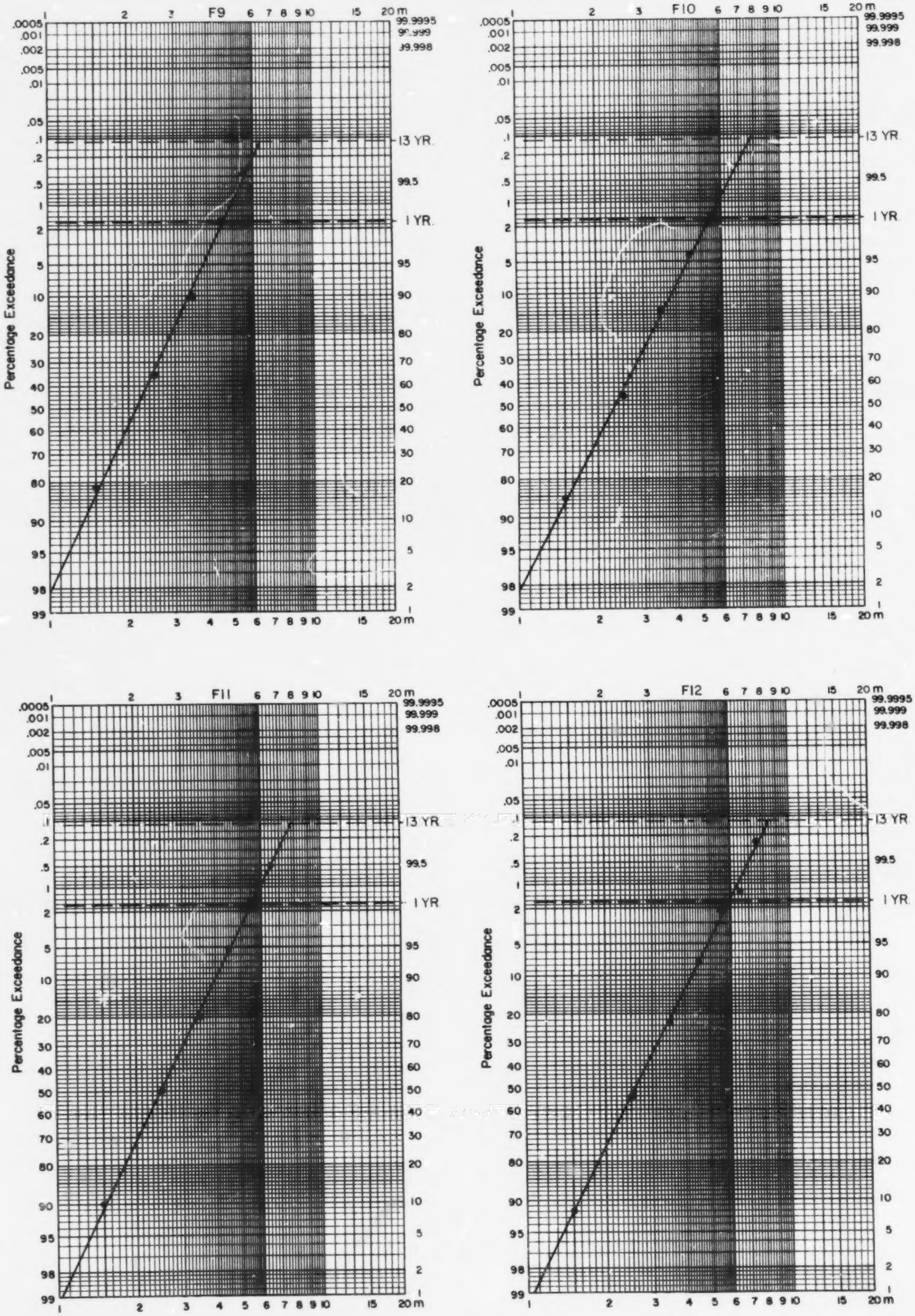
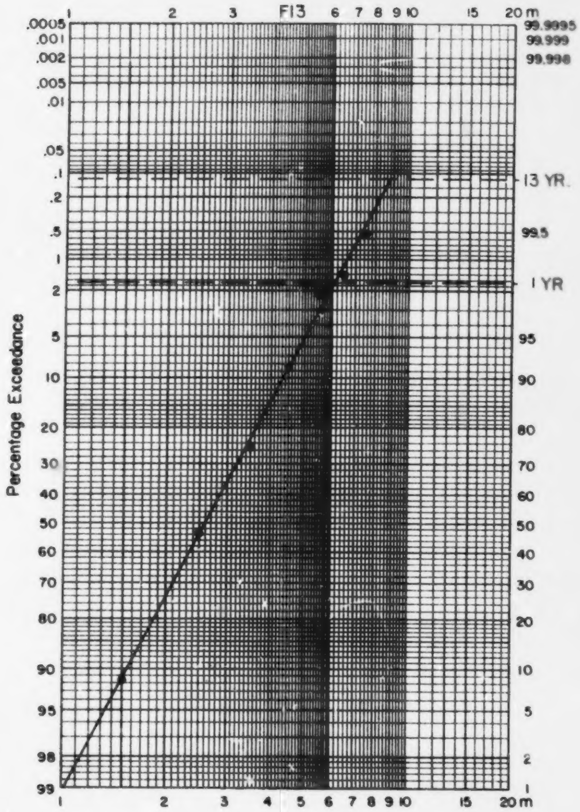
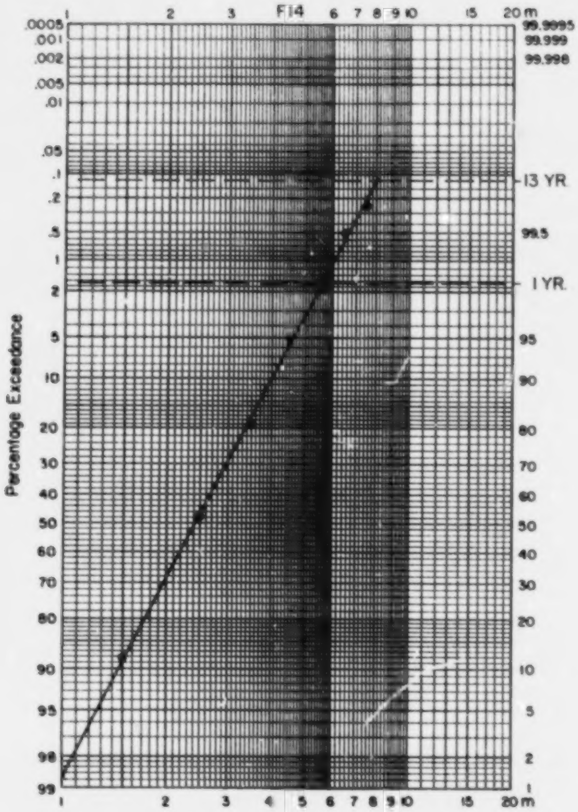
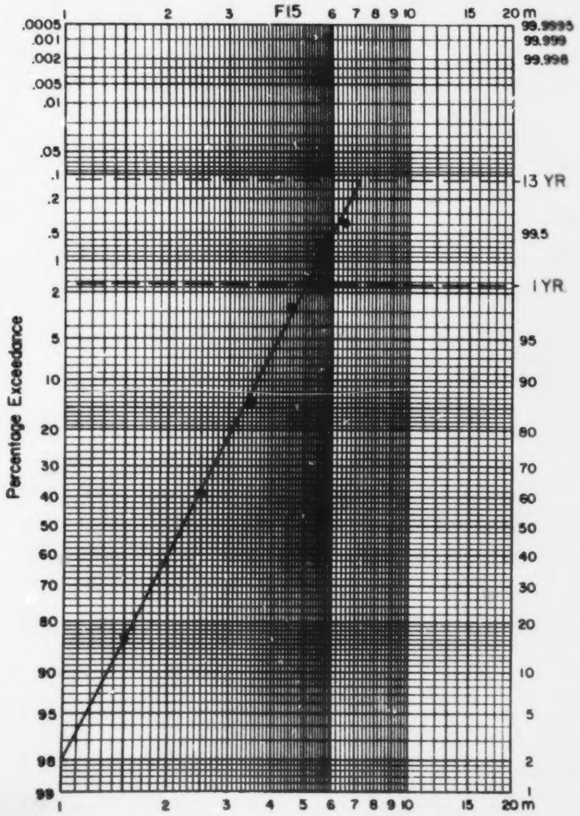


Figure 7a. Monthly Wave Height Exceedance Distribution for July







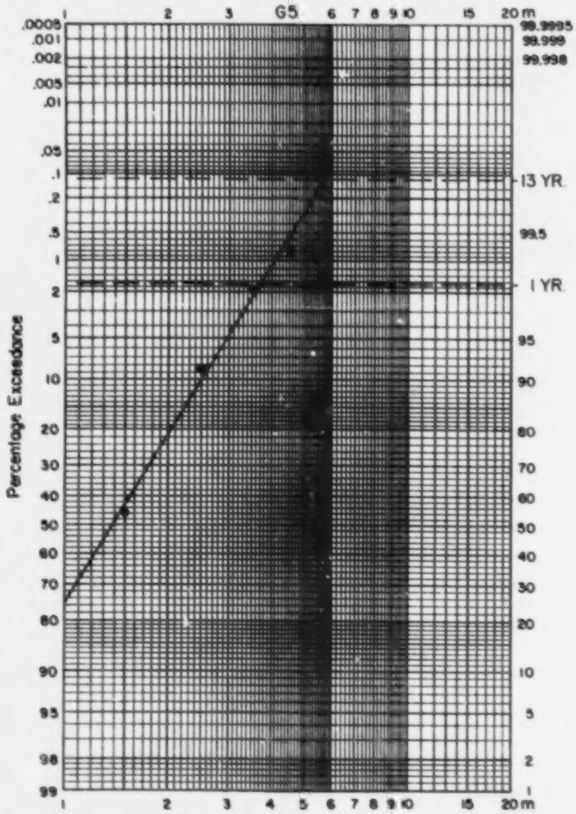


Figure 7r. Monthly Wave Height Exceedance Distribution for July

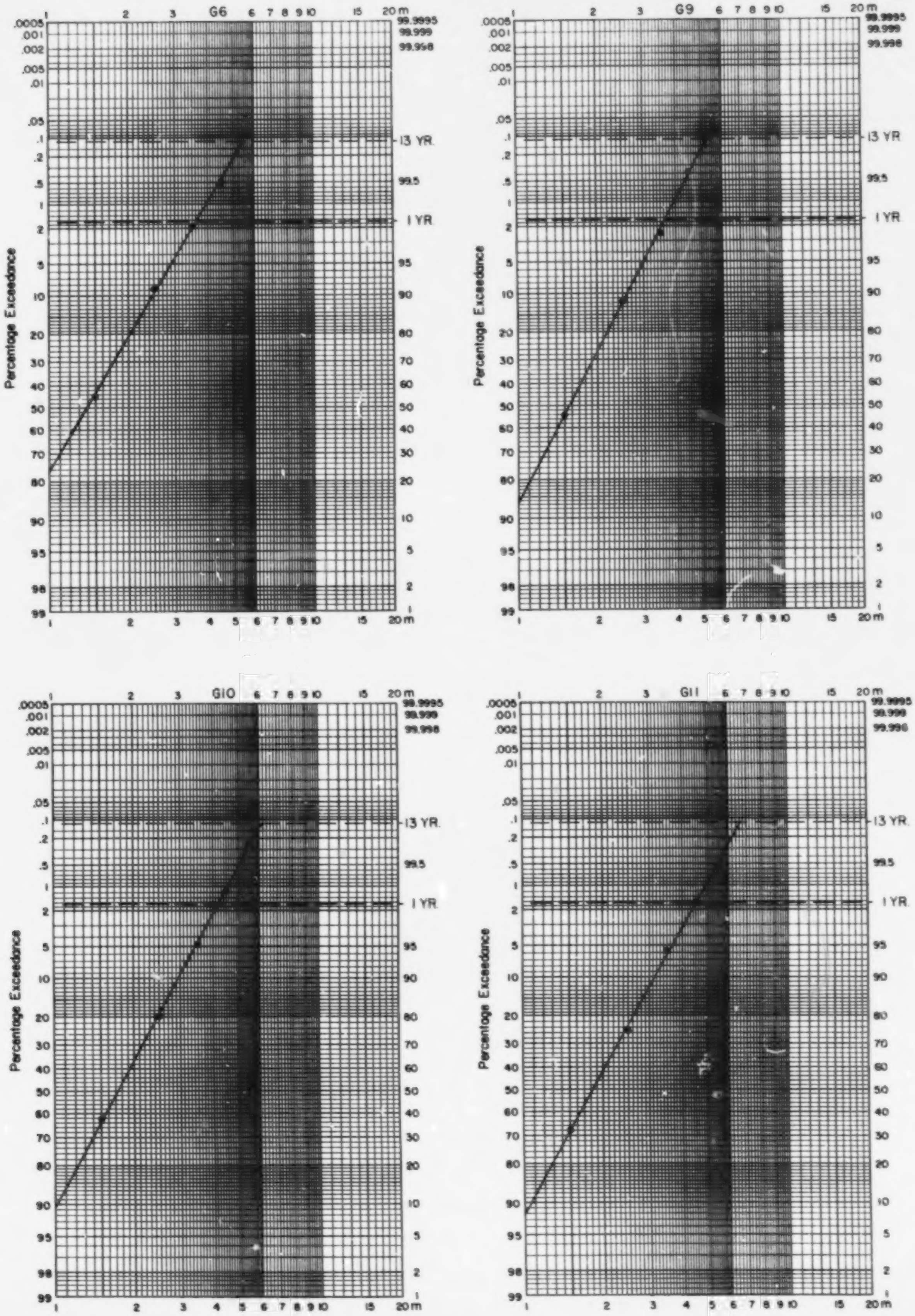


Figure 7s. Monthly Wave Height Exceedance Distribution for July

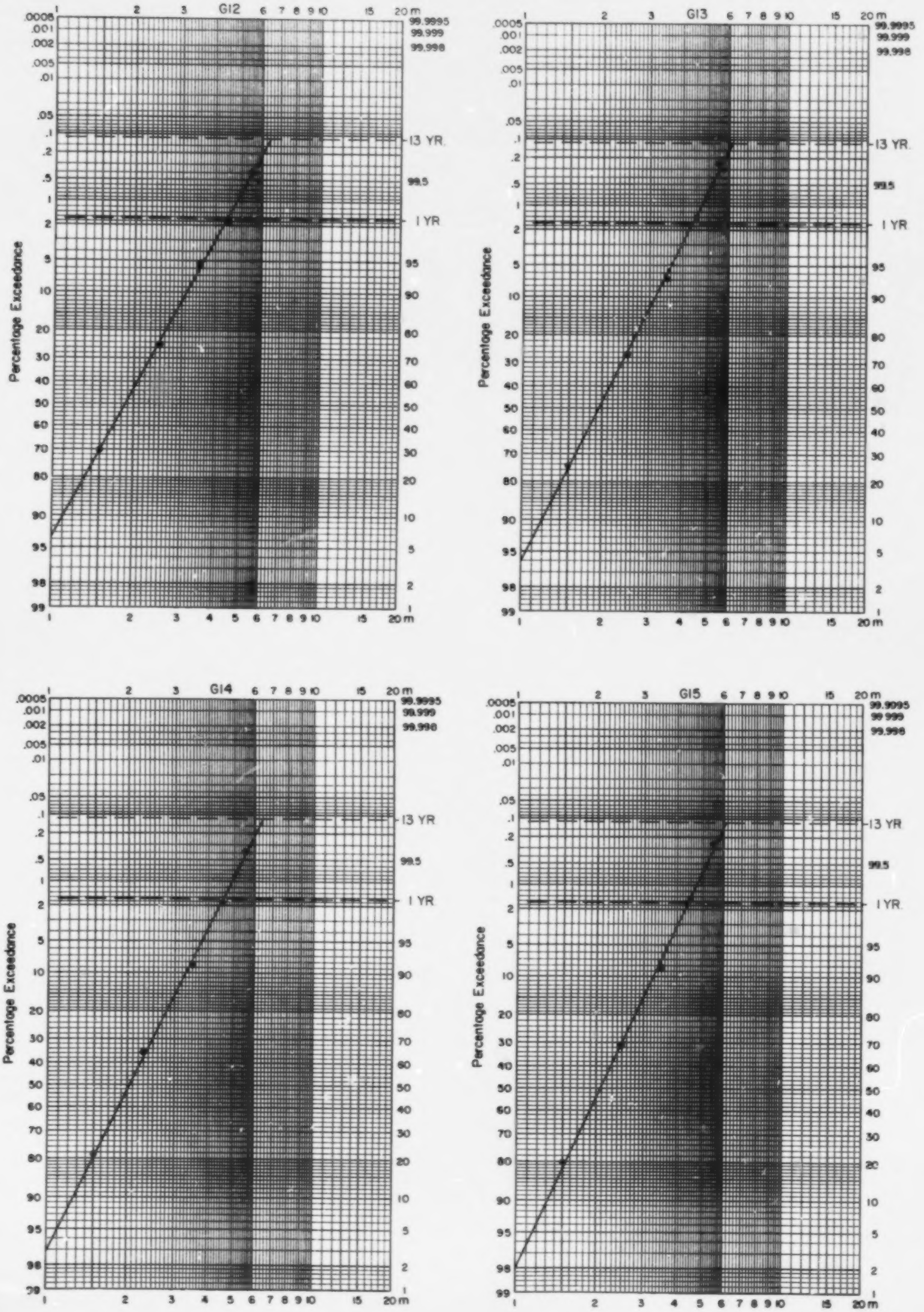


Figure 71. Monthly Wave Height Exceedance Distribution for July

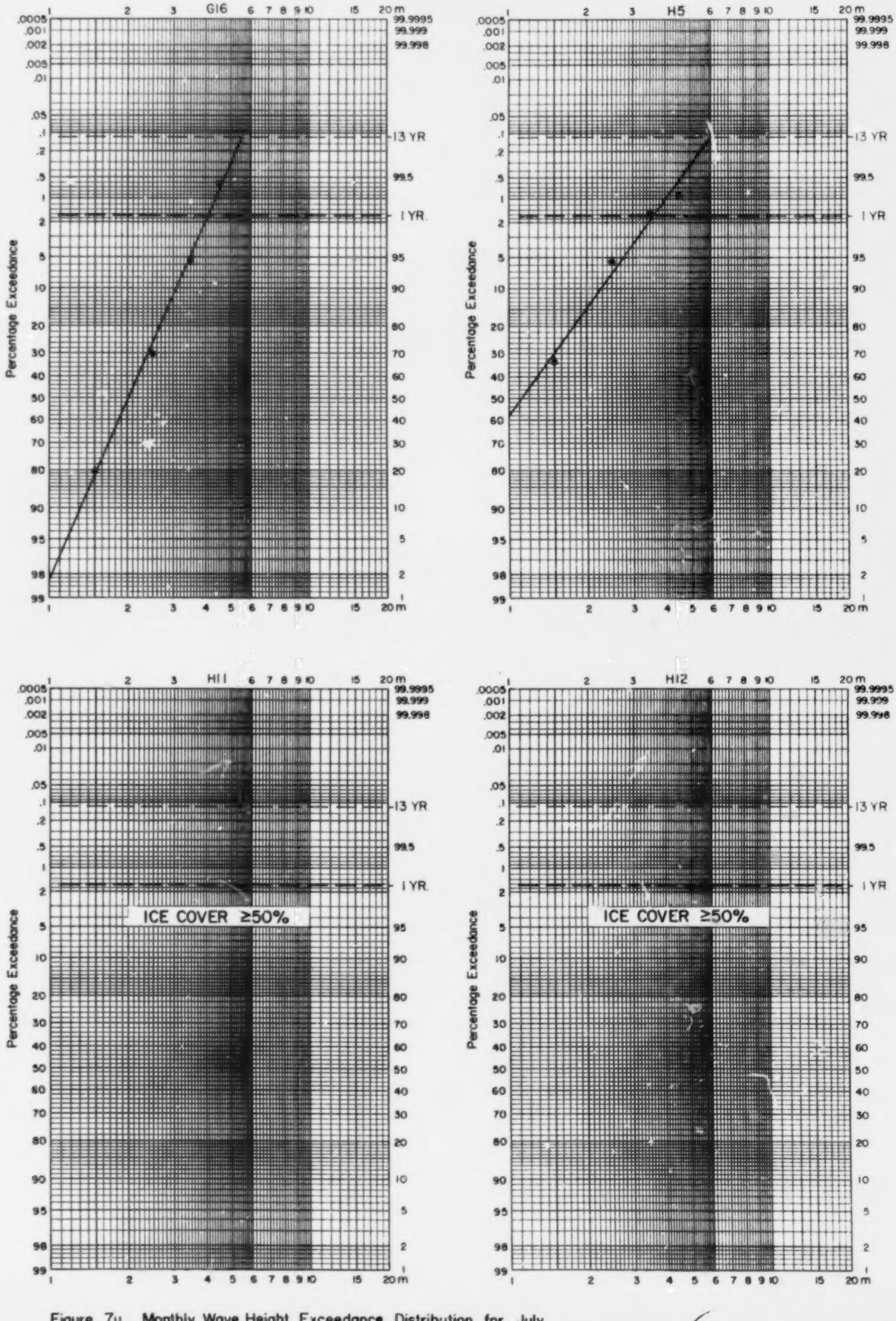


Figure 7u. Monthly Wave Height Exceedance Distribution for July

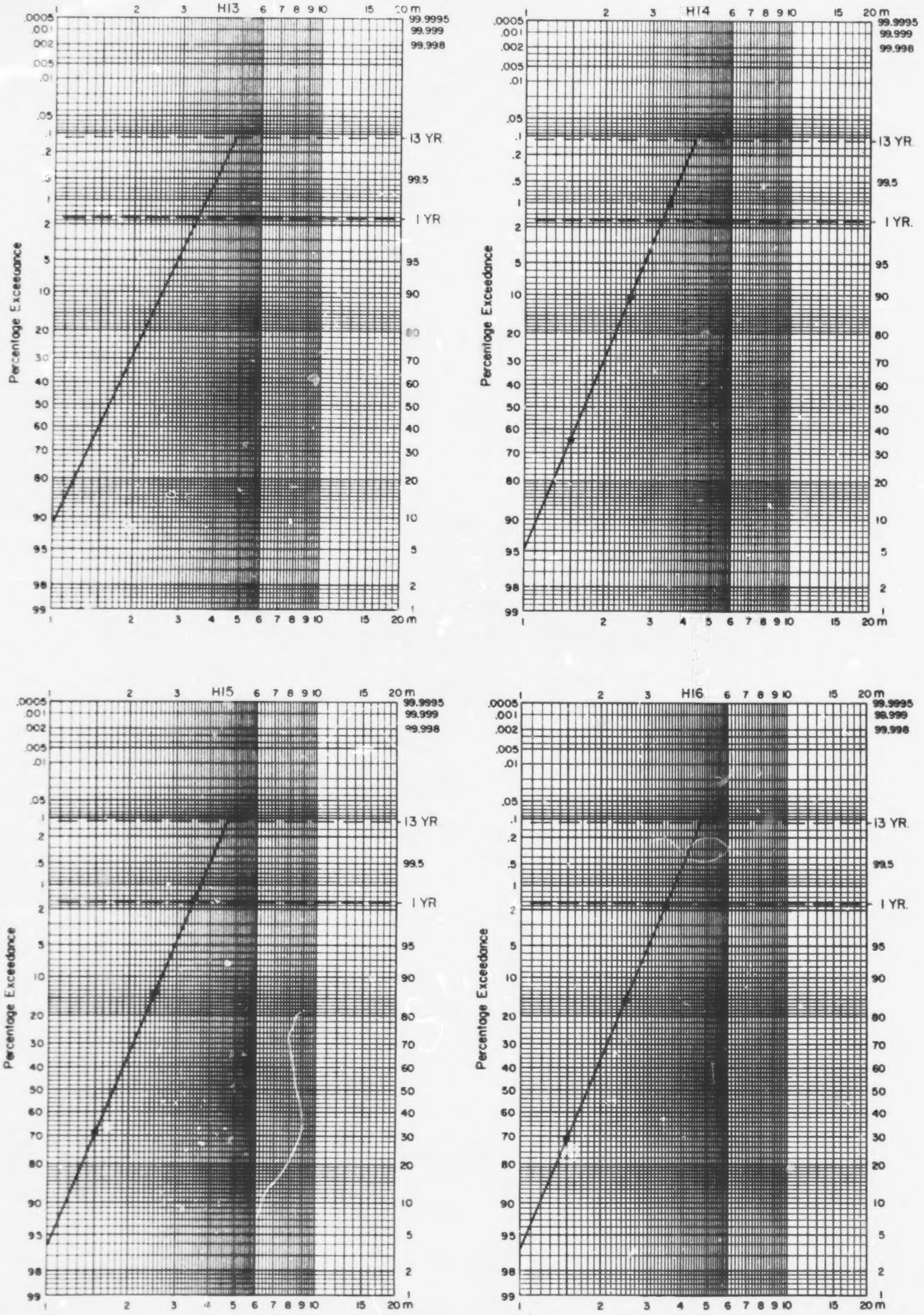


Figure 7v. Monthly Wave Height Exceedance Distribution for July

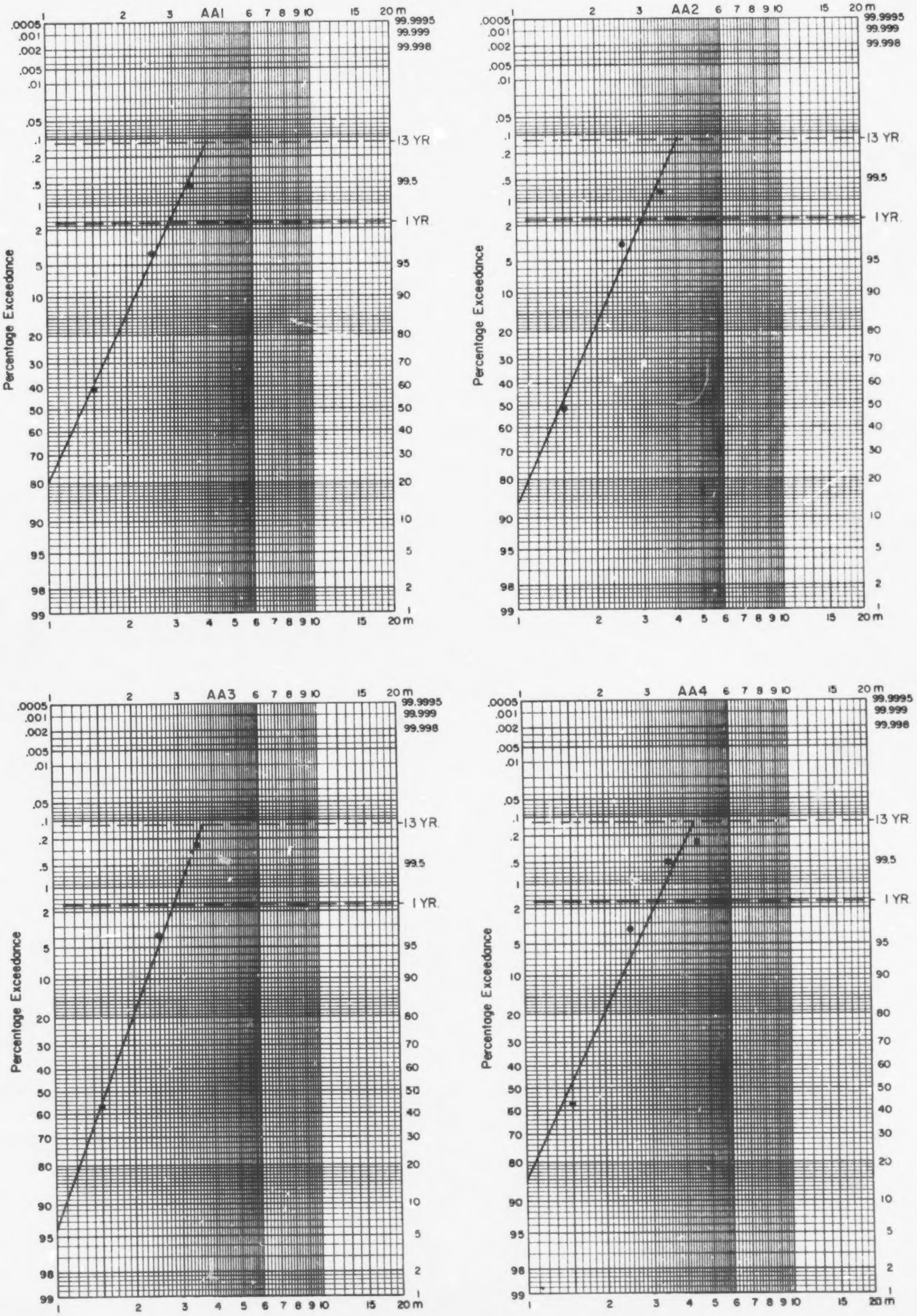


Figure 8a. Monthly Wave Height Exceedance Distribution for August

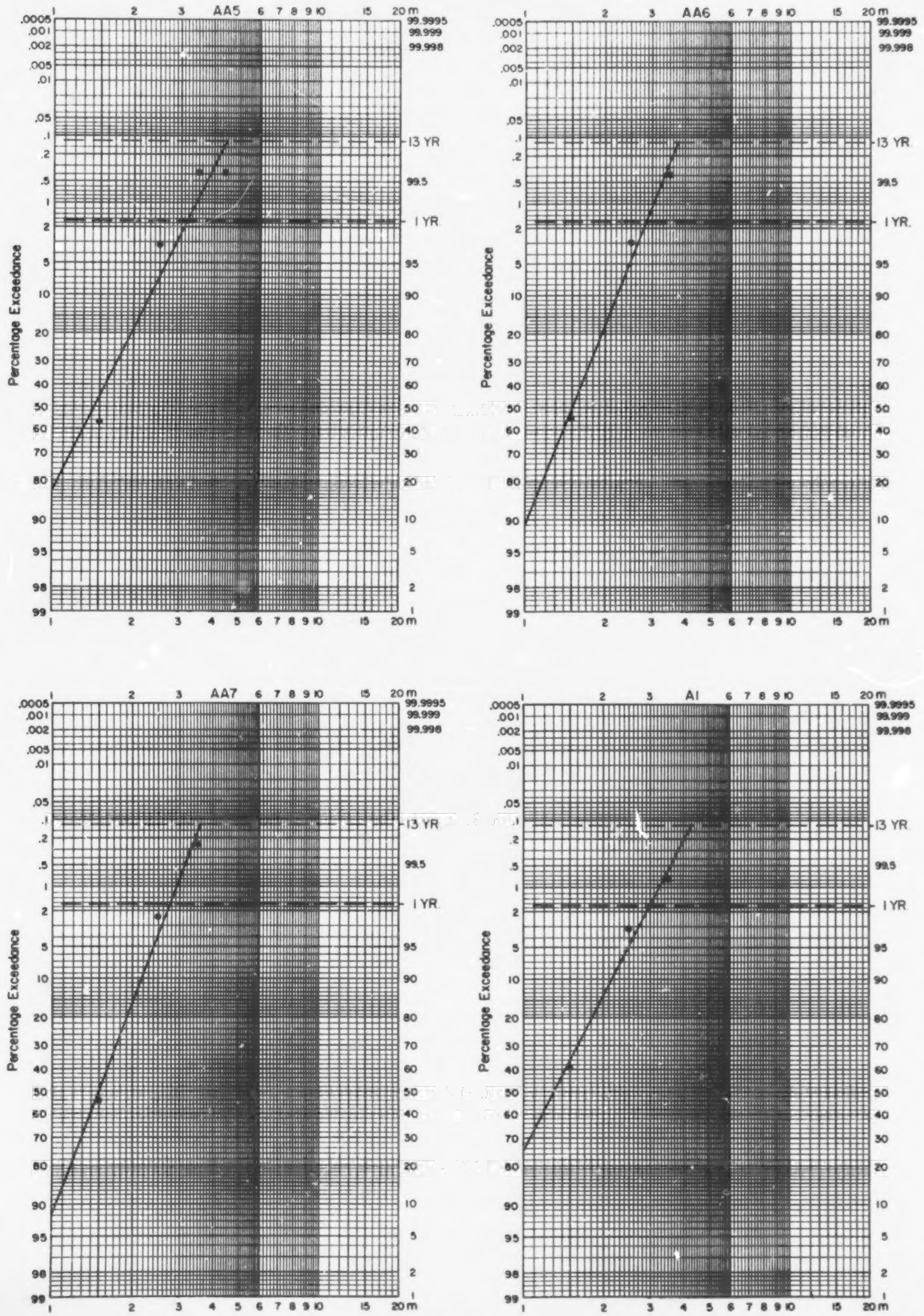


Figure 8b. Monthly Wave Height Exceedance Distribution for August

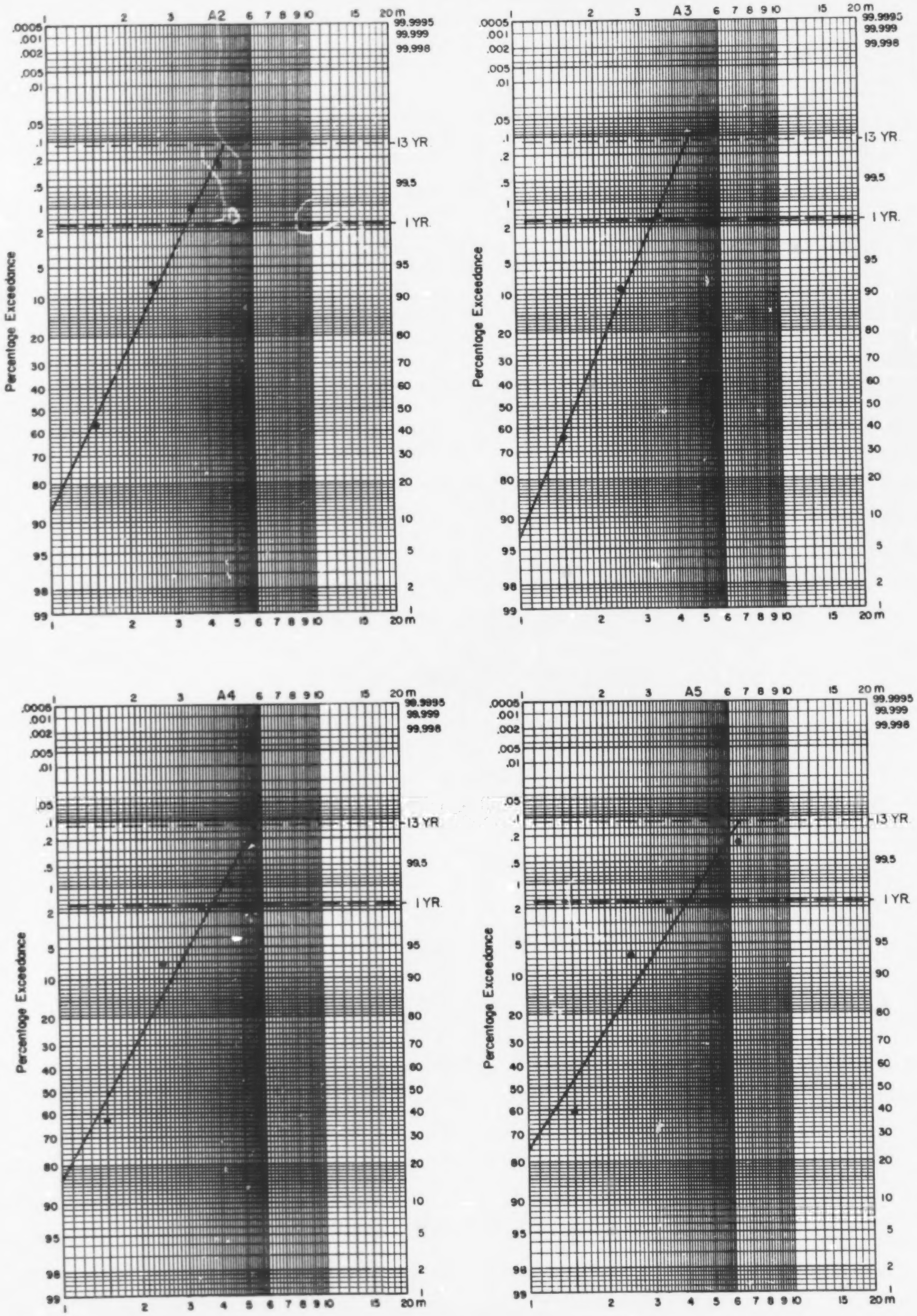


Figure 8c. Monthly Wave Height Exceedance Distribution for August

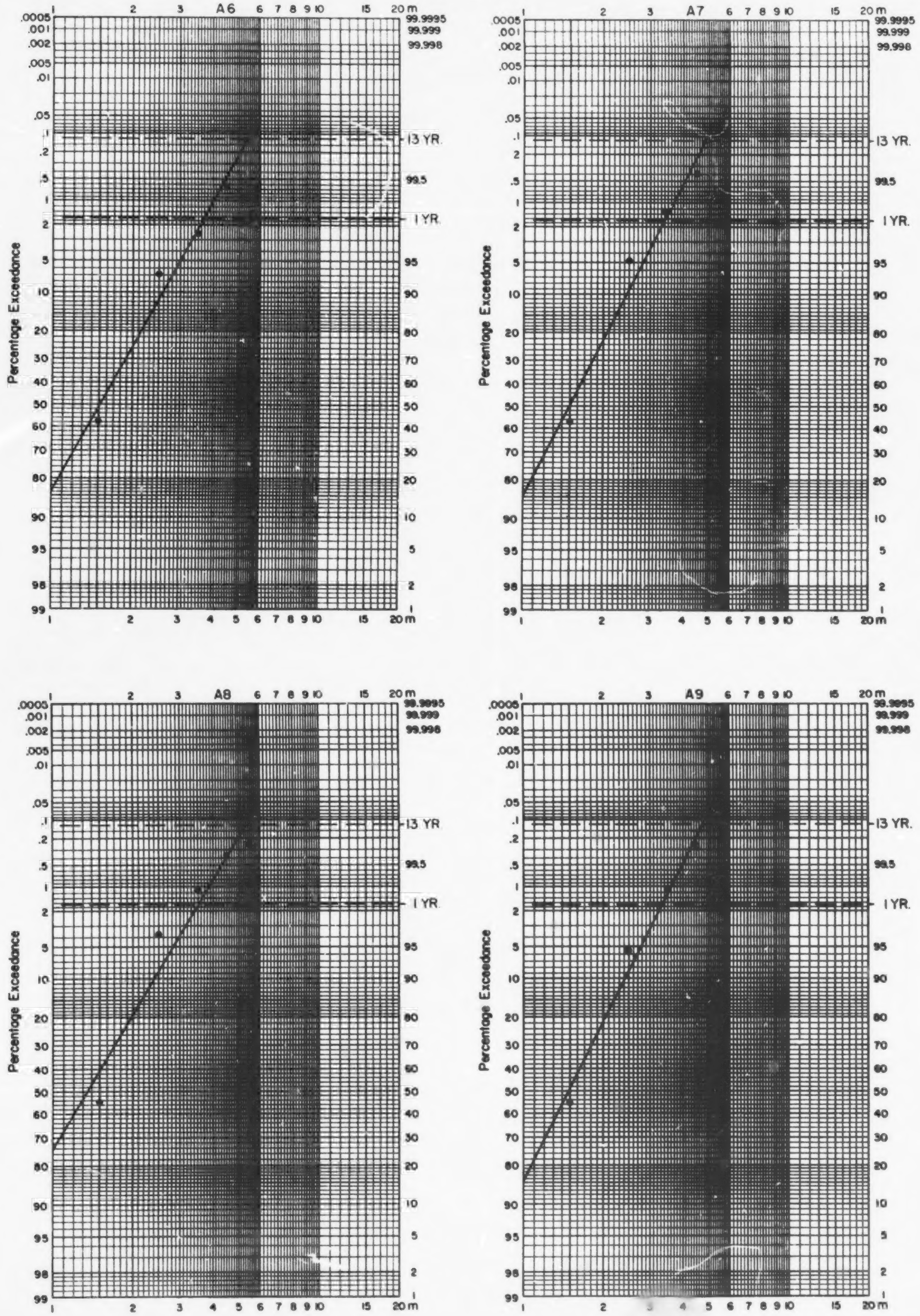


Figure 8d. Monthly Wave Height Exceedance Distribution for August

Figure 7m. Monthly Wave Height Exceedance Distribution for July

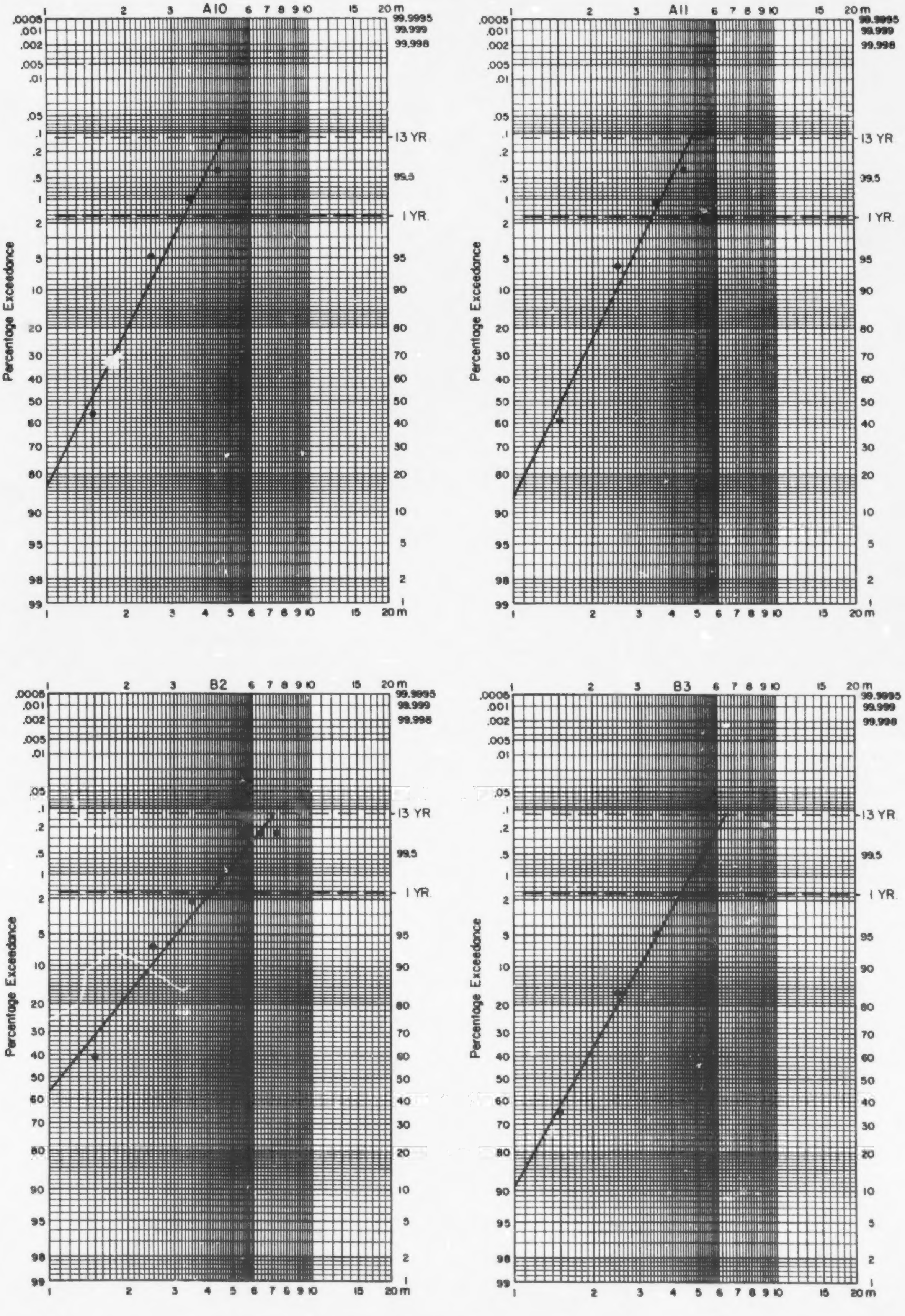


Figure 8e. Monthly Wave Height Exceedance Distribution for August

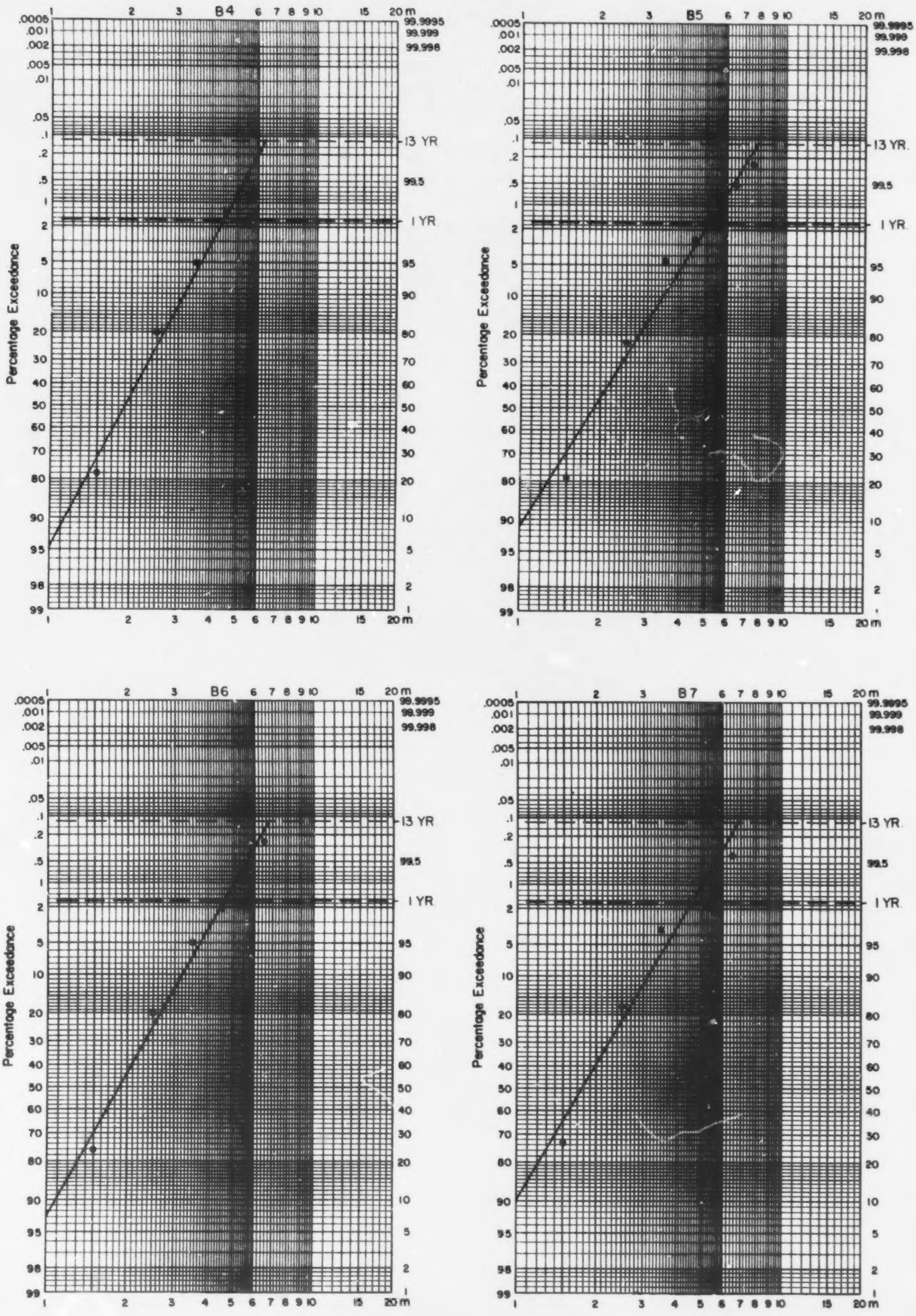


Figure 8f. Monthly Wave Height Exceedance Distribution for August

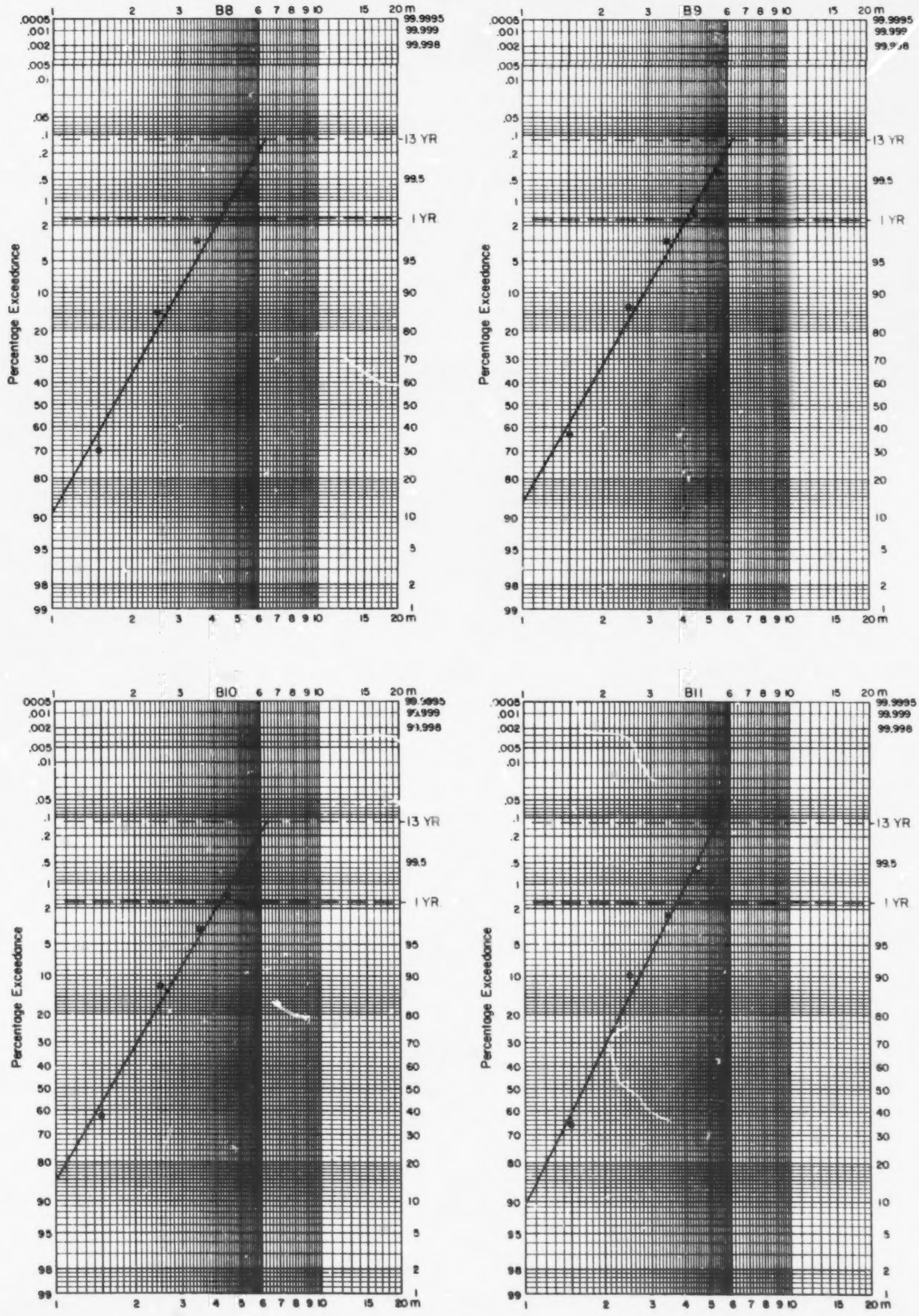


Figure 8g. Monthly Wave Height Exceedance Distribution for August

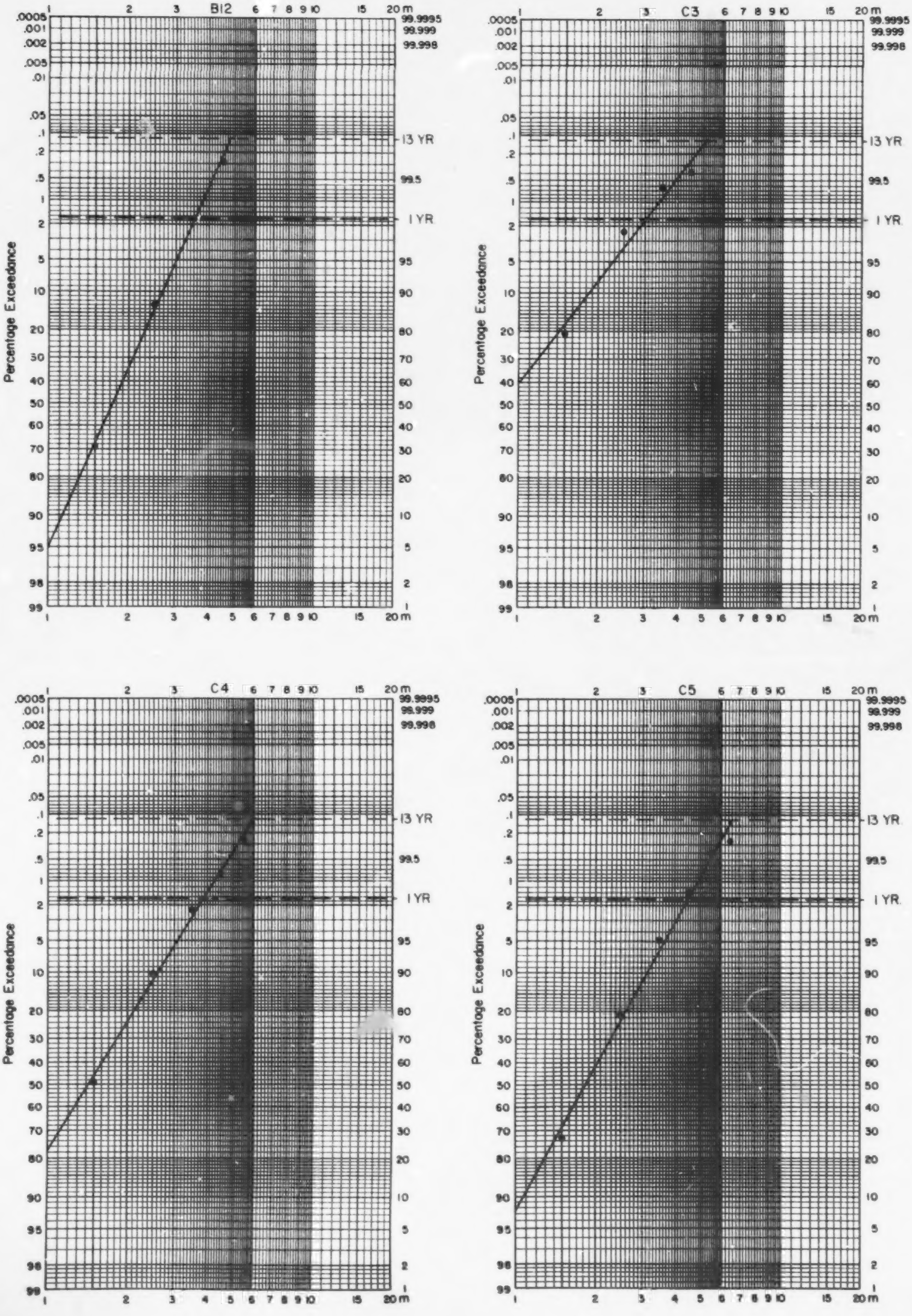


Figure 8h. Monthly Wave Height Exceedance Distribution for August

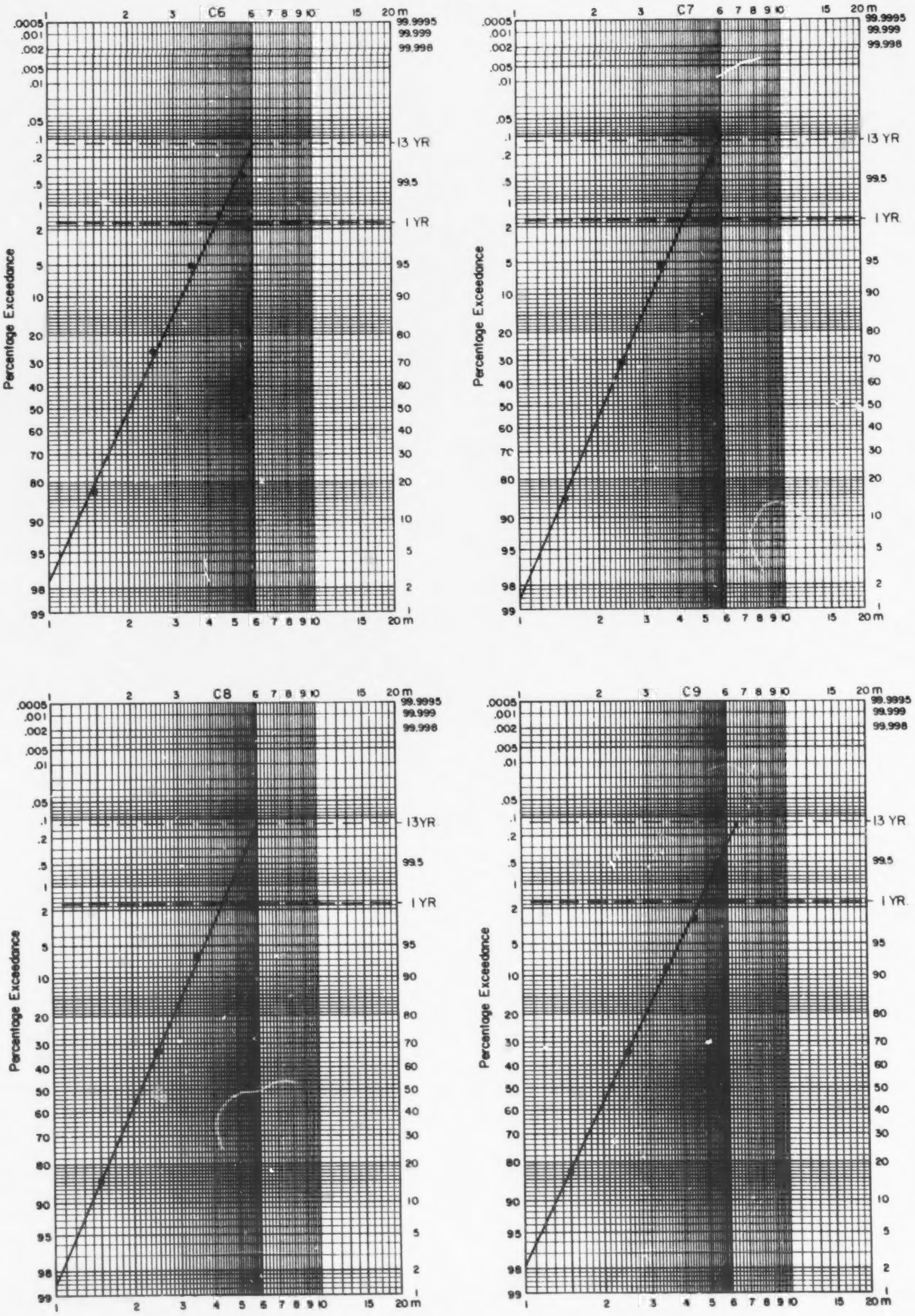


Figure 8i. Monthly Wave Height Exceedance Distribution for August

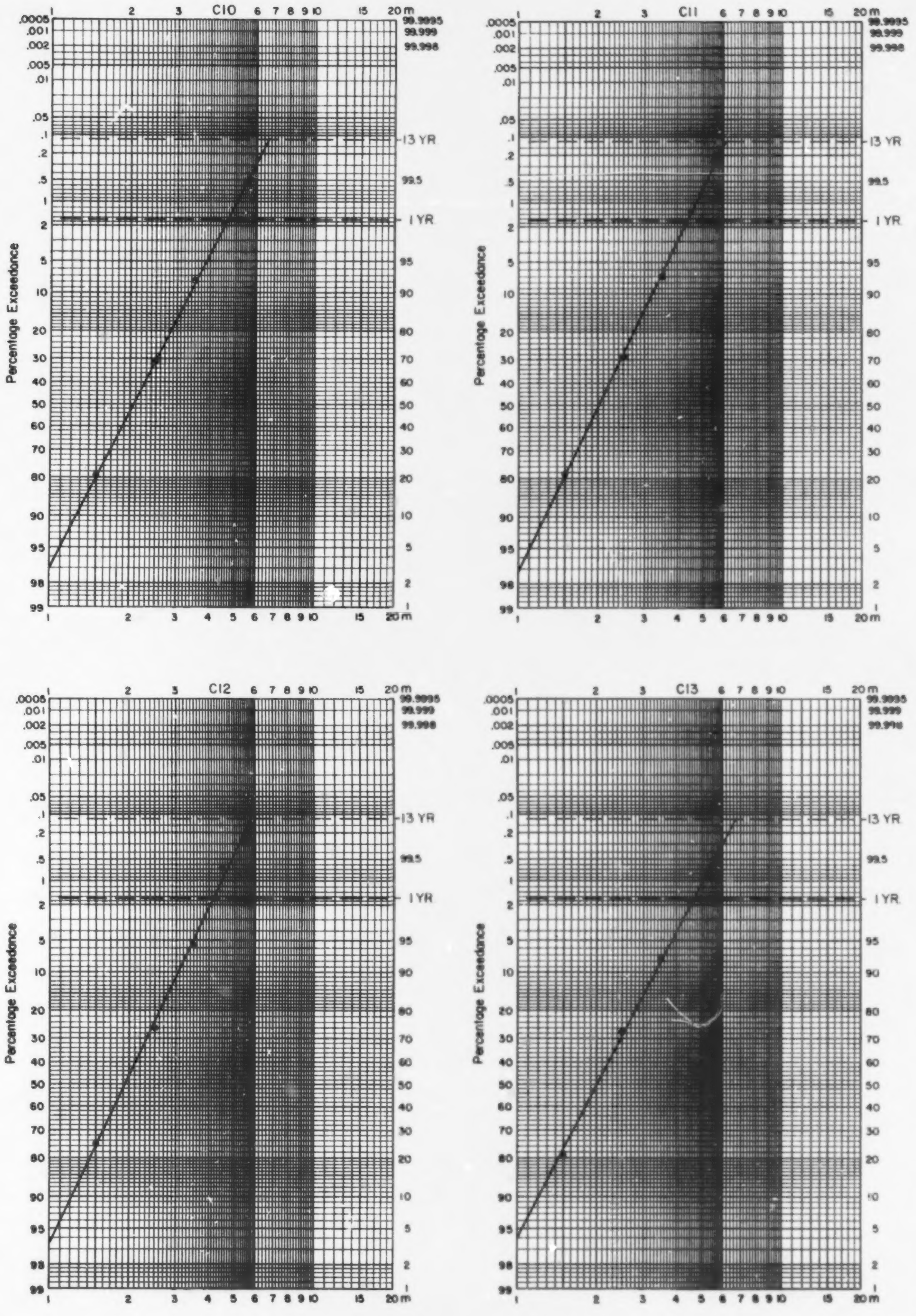


Figure 8j. Monthly Wave Height Exceedance Distribution for August

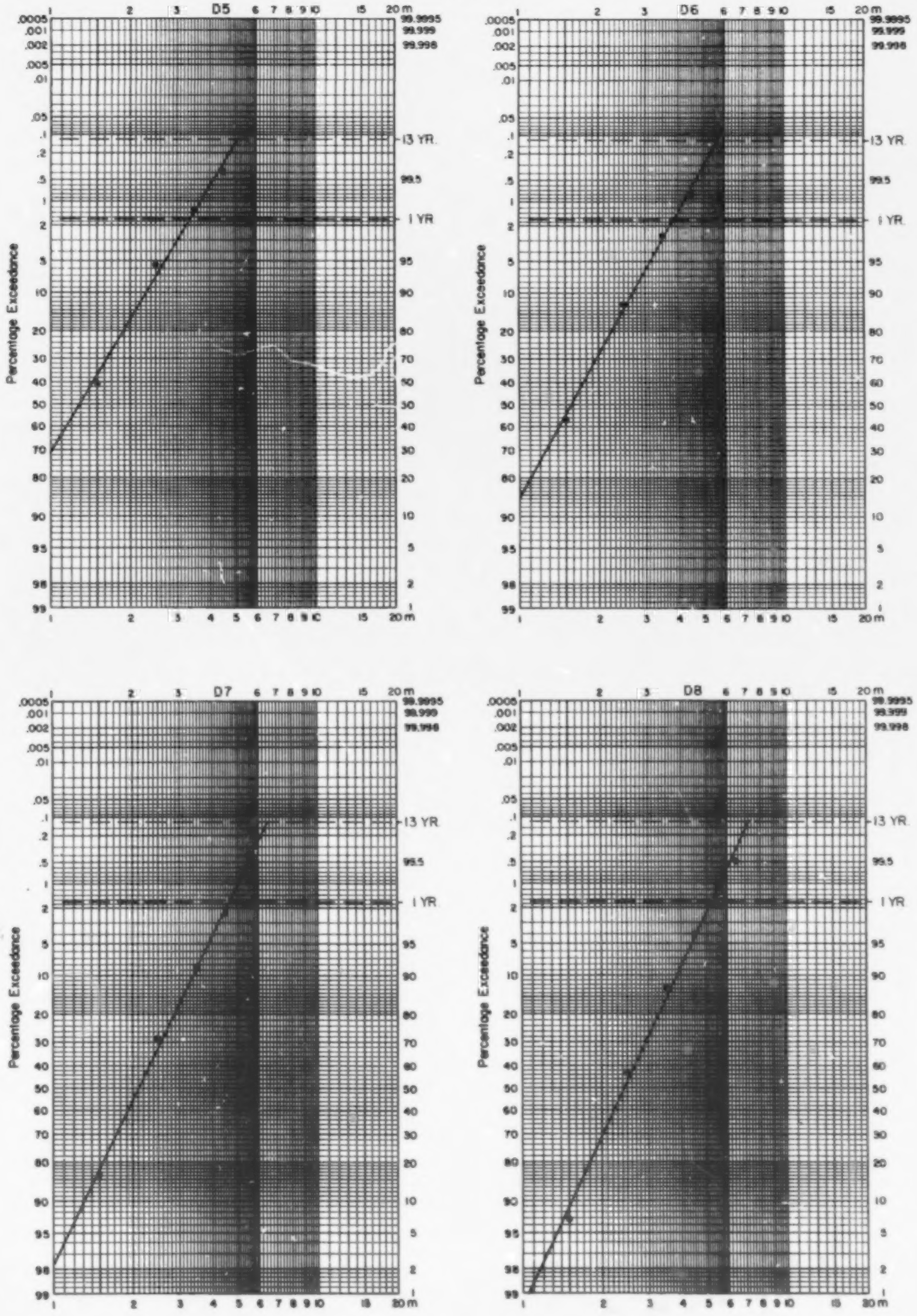


Figure 8k. Monthly Wave Height Exceedance Distribution for August

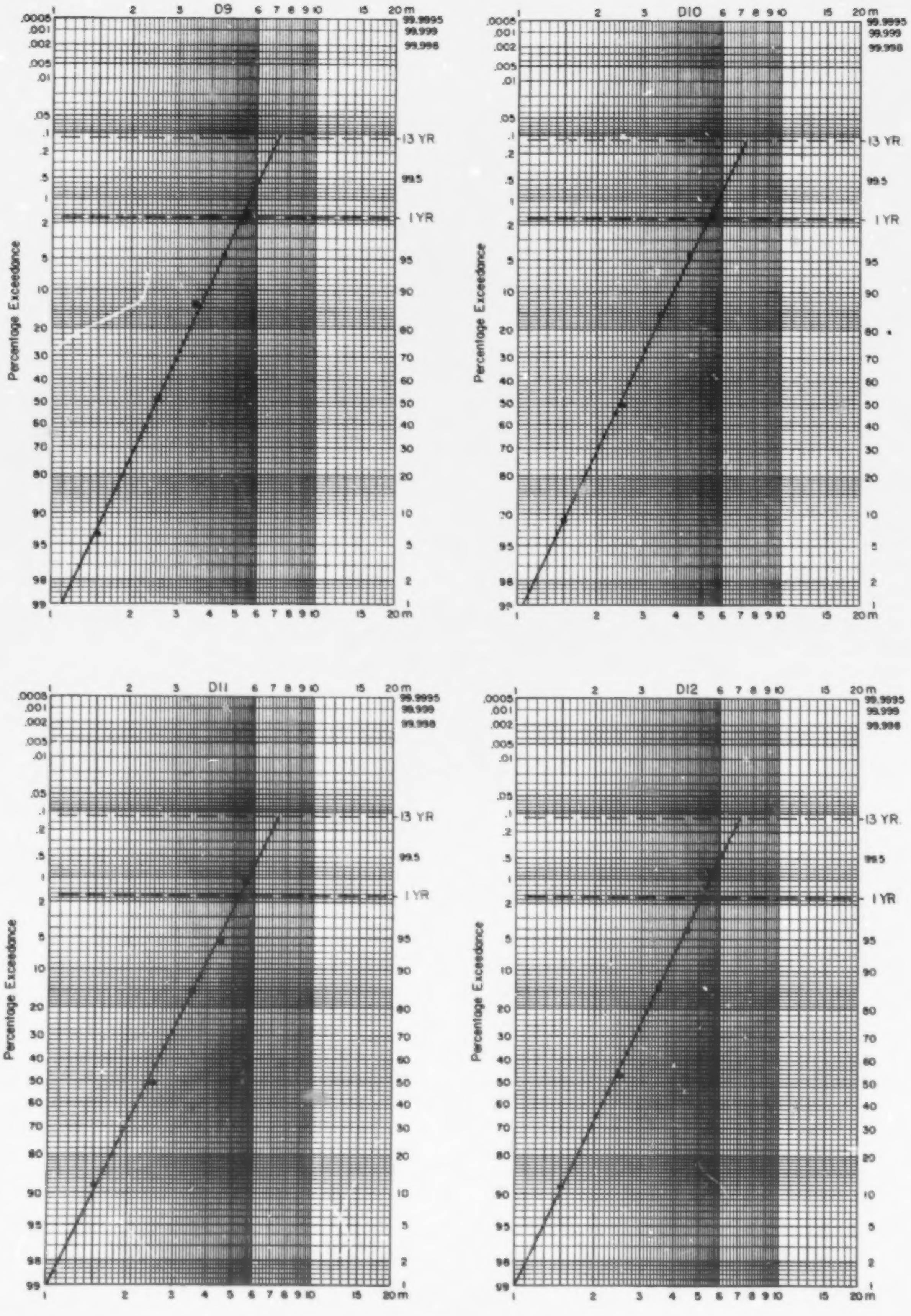


Figure 81. Monthly Wave Height Exceedance Distribution for August

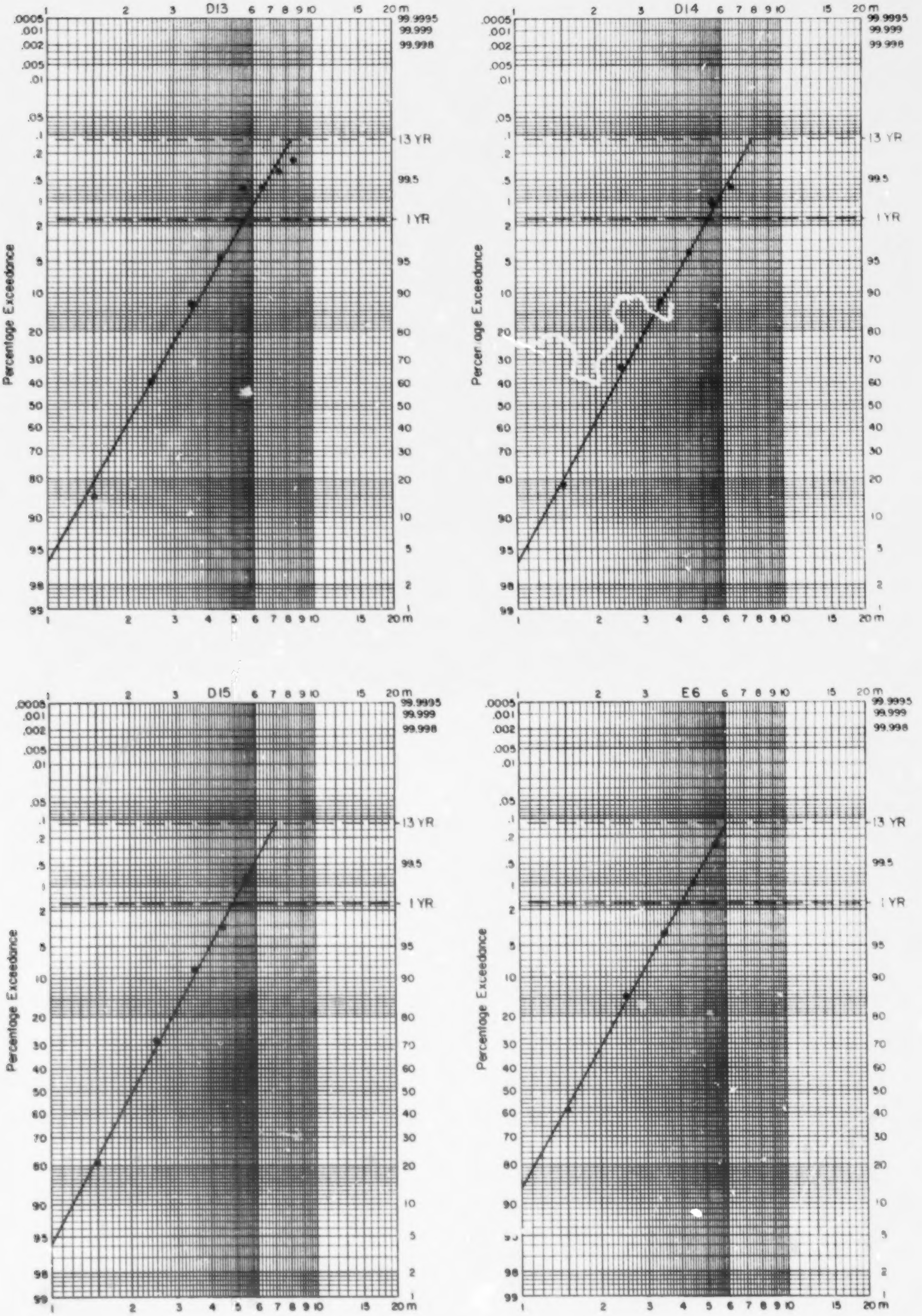


Figure 8m. Monthly Wave Height Exceedance Distribution for August

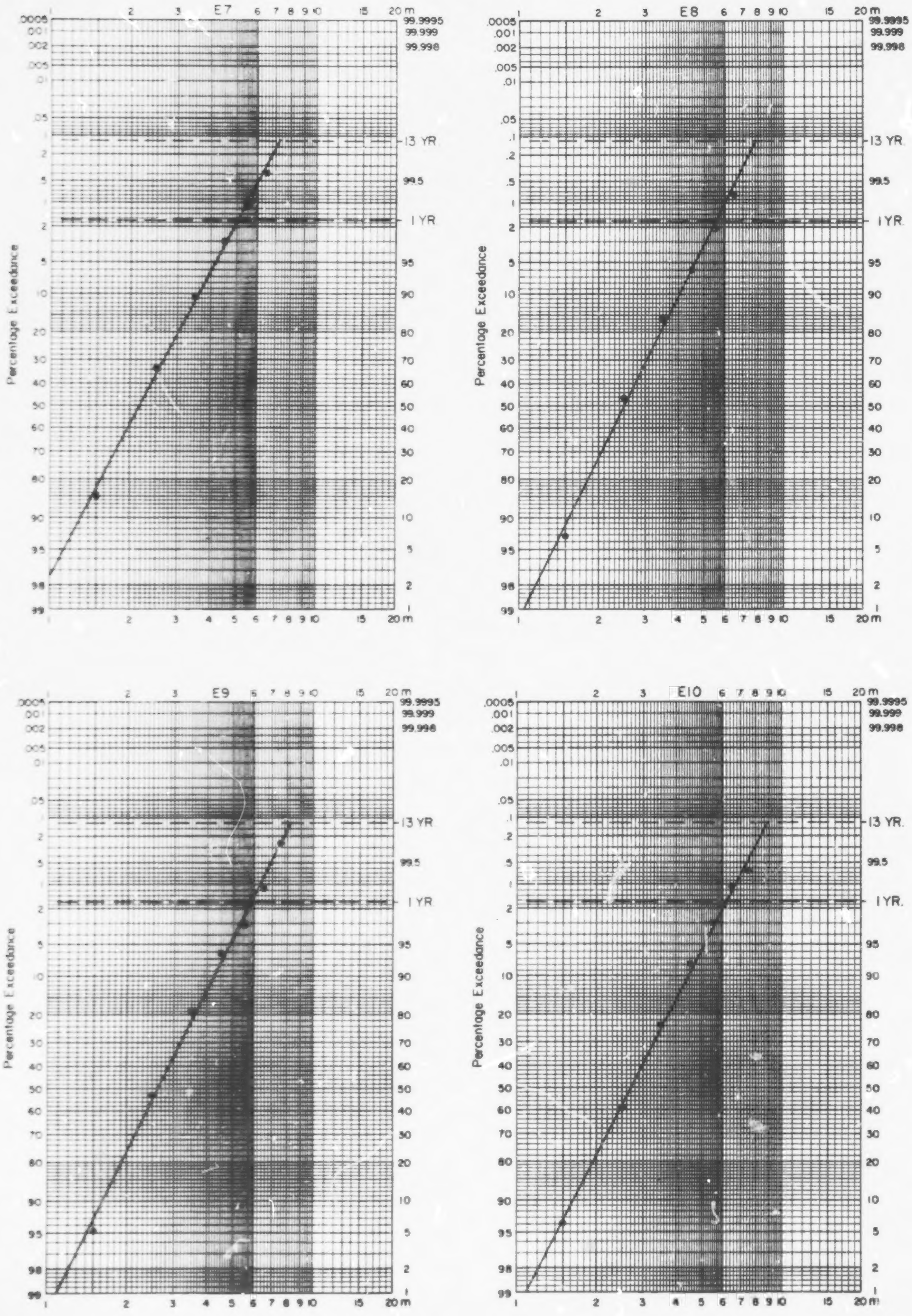


Figure 8n. Monthly Wave Height Exceedance Distribution for August

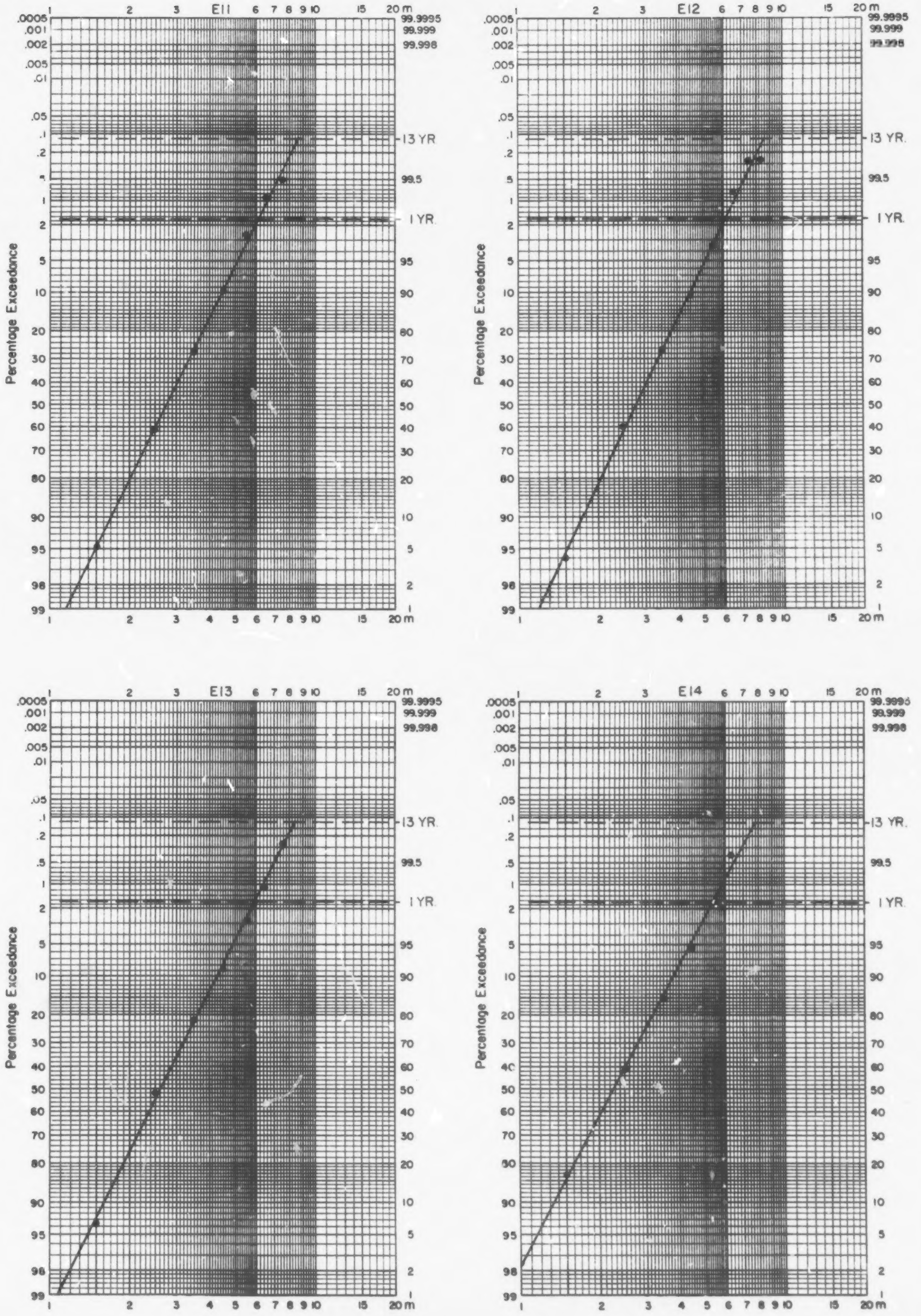


Figure 8o. Monthly Wave Height Exceedance Distribution for August

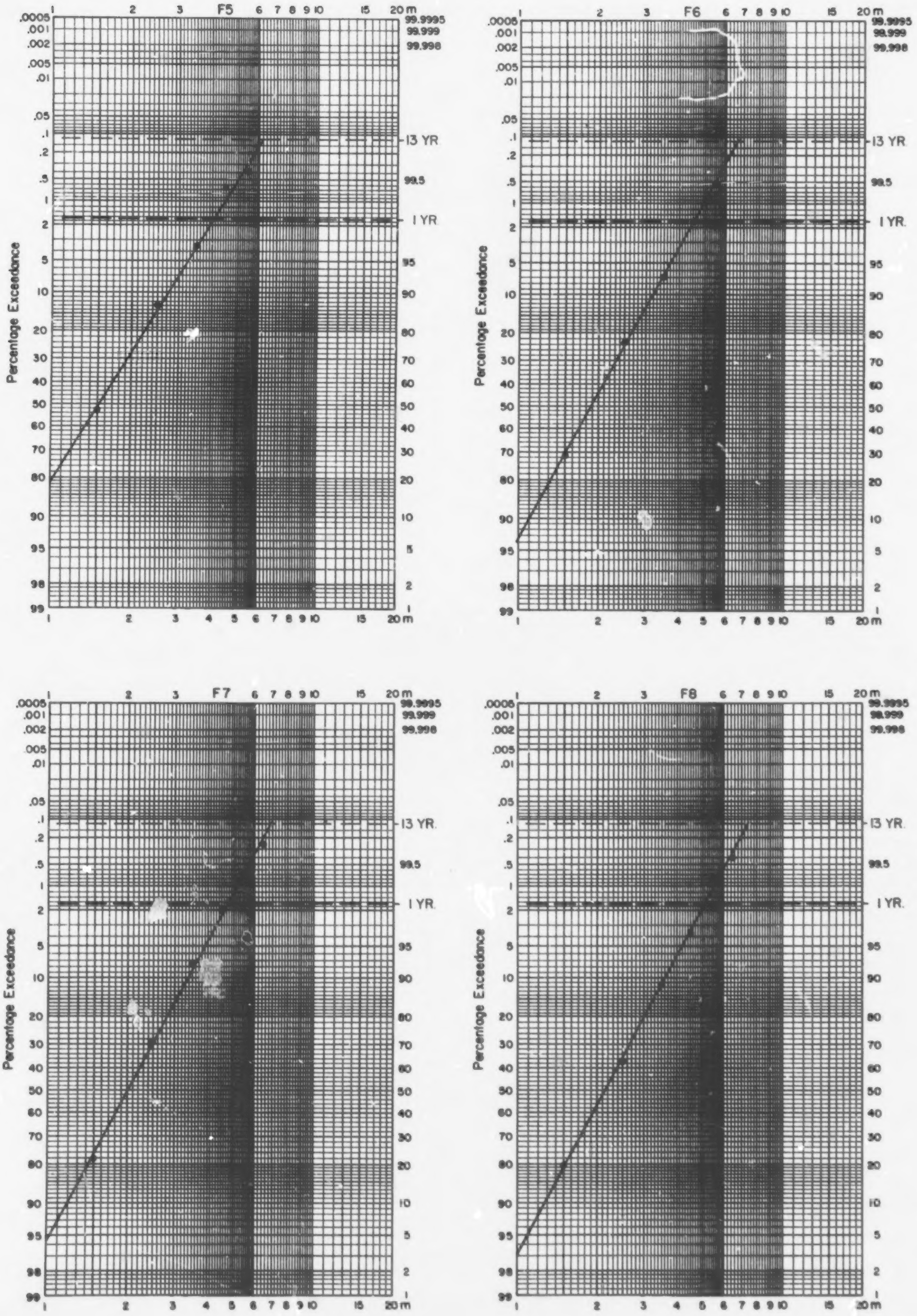


Figure 8p. Monthly Wave Height Exceedance Distribution for August

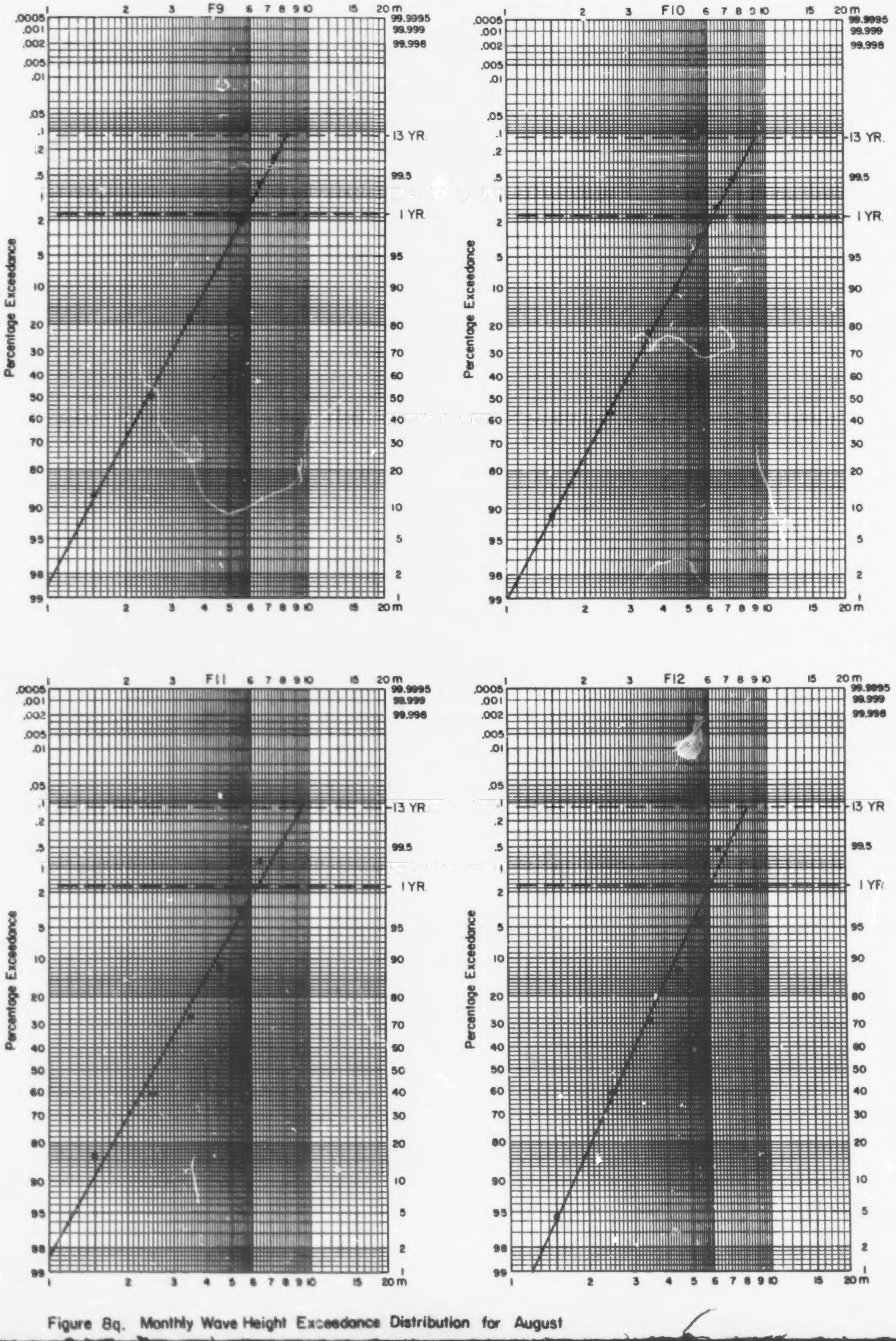
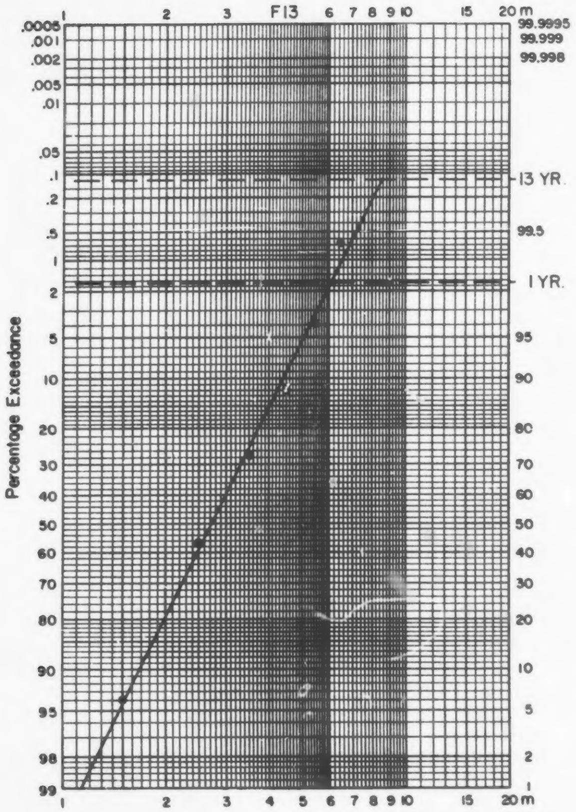
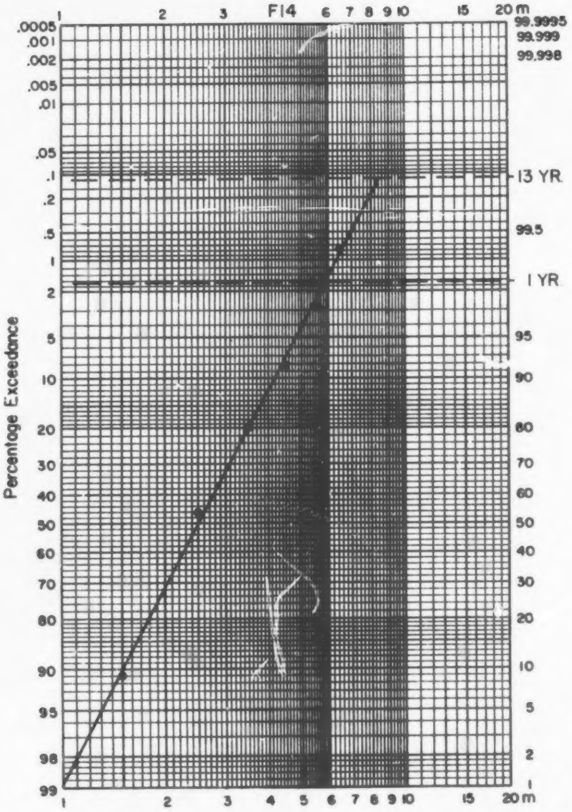
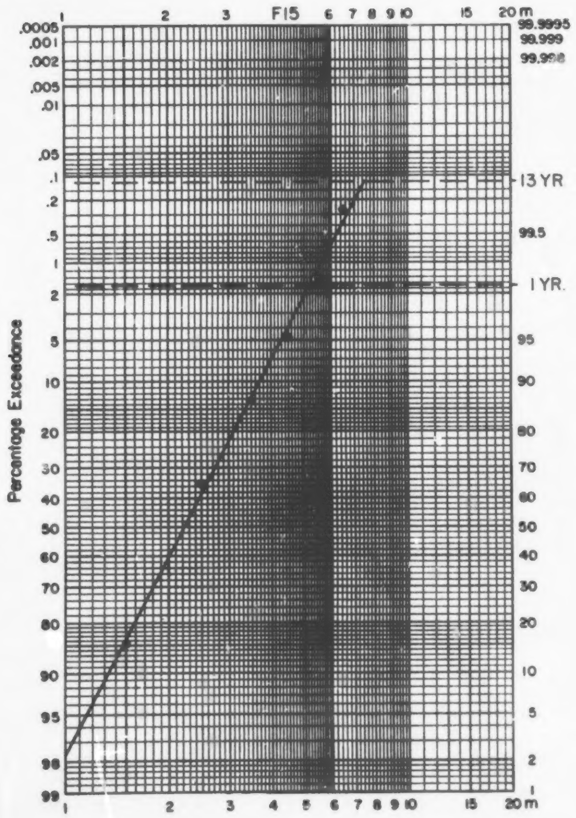


Figure 8q. Monthly Wave Height Exceedance Distribution for August







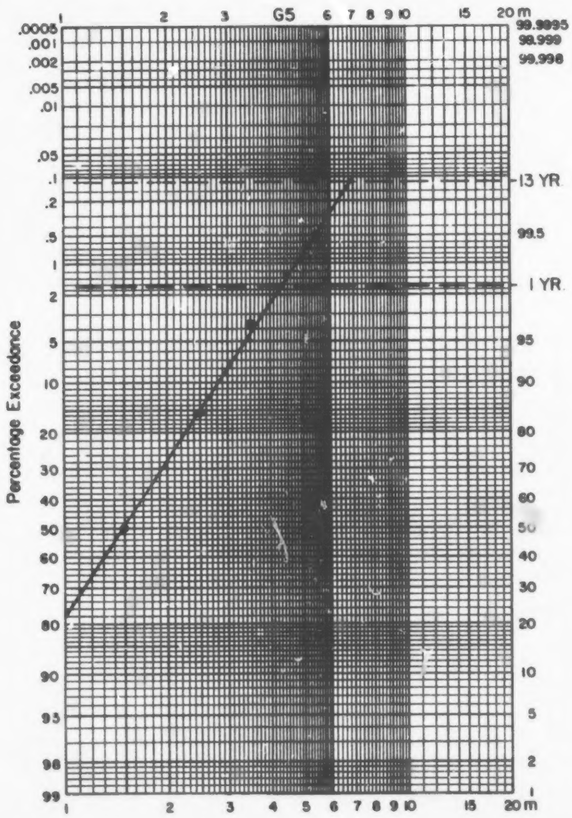


Figure 8r. Monthly Wave Height Exceedance Distribution for August

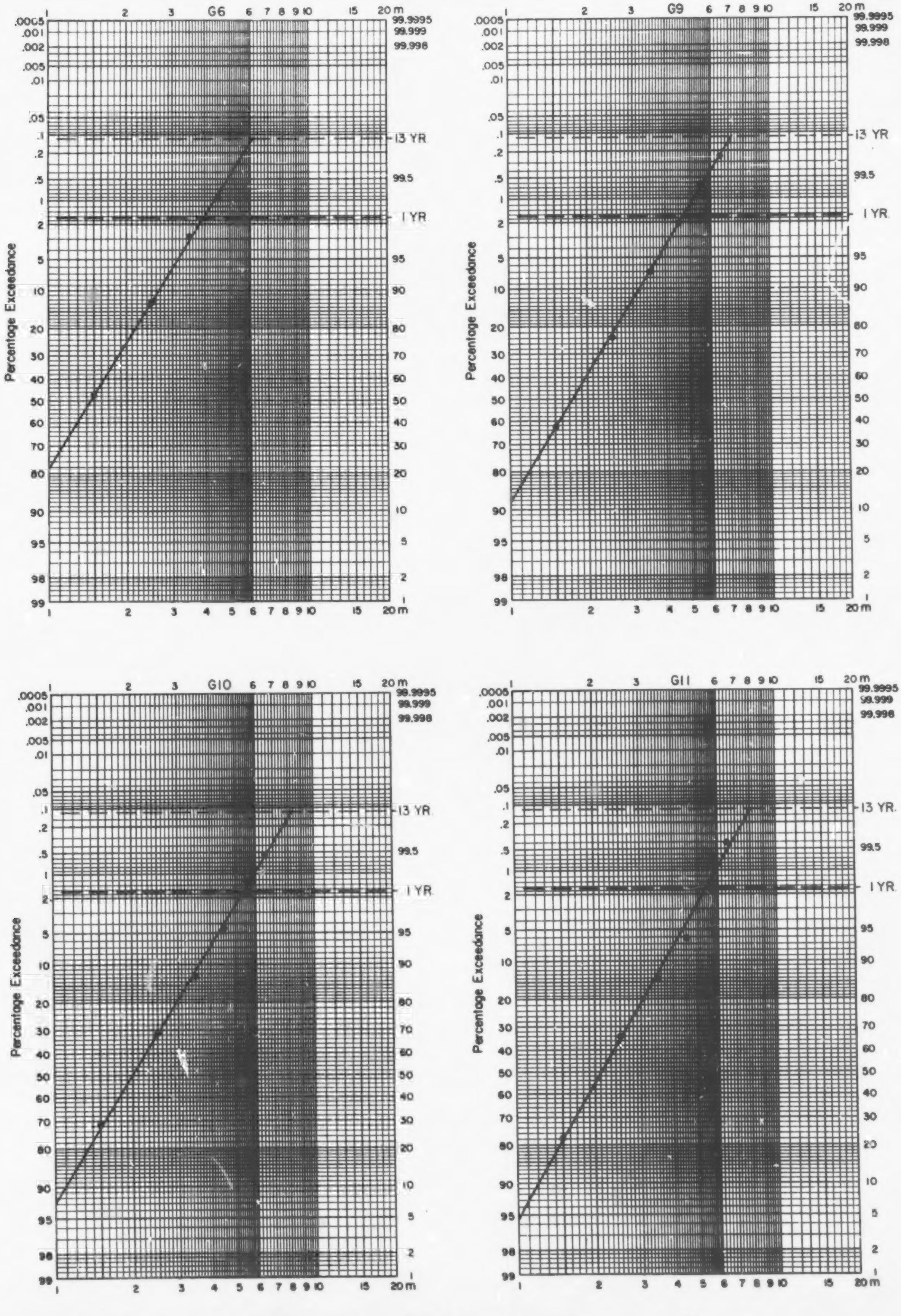


Figure 8s. Monthly Wave Height Exceedance Distribution for August

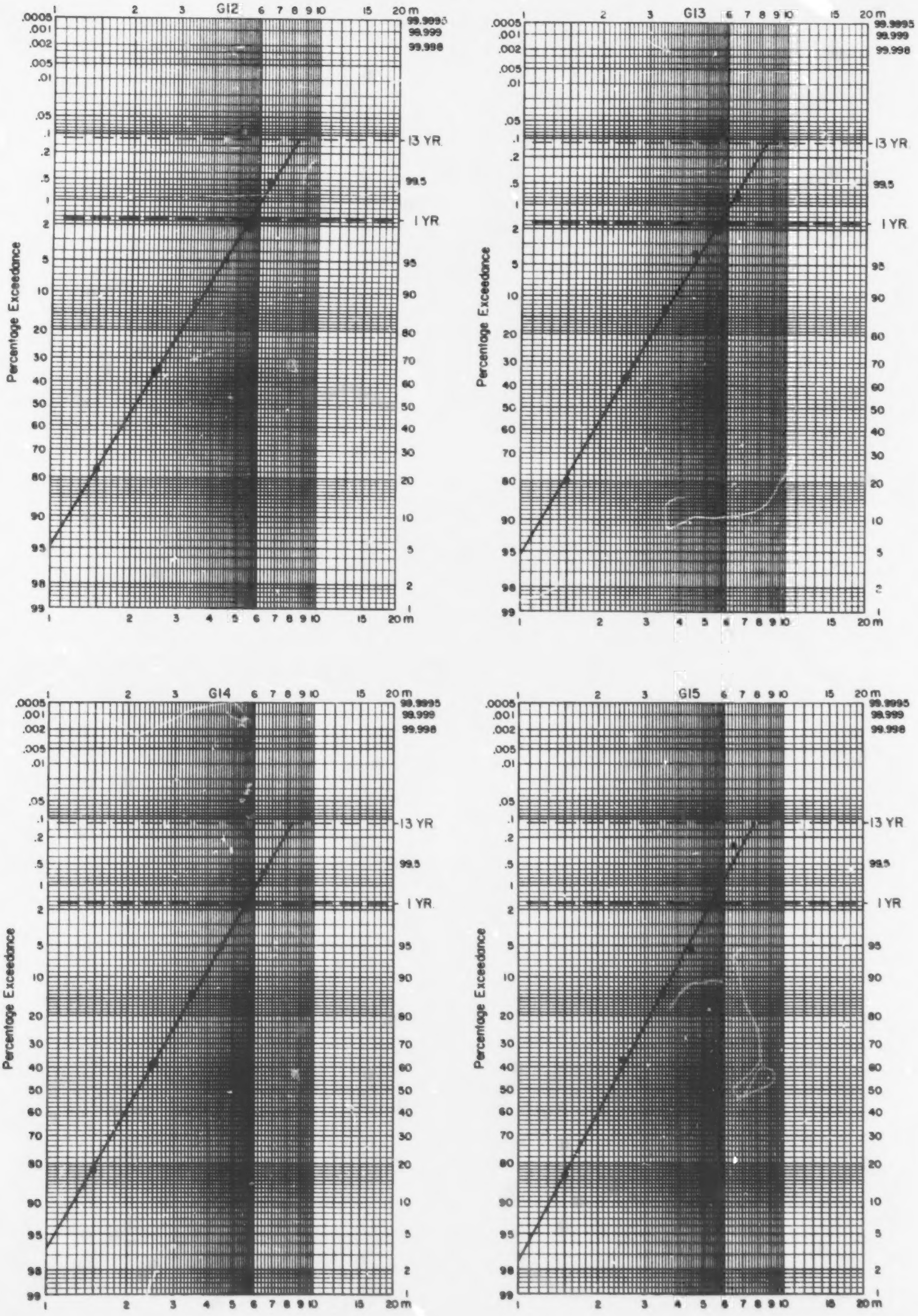


Figure 81. Monthly Wave Height Exceedance Distribution for August

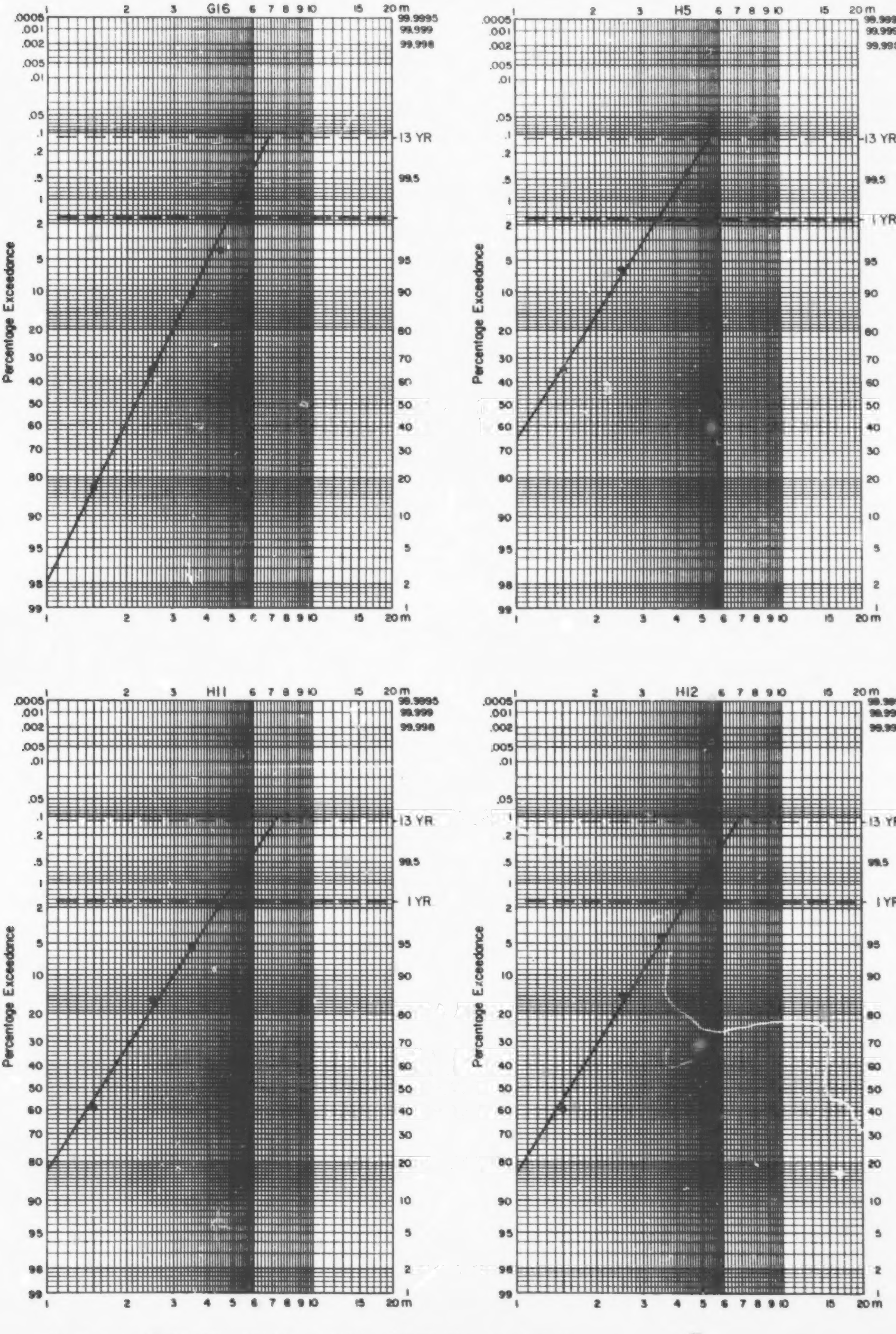


Figure 8u. Monthly Wave Height Exceedance Distribution for August

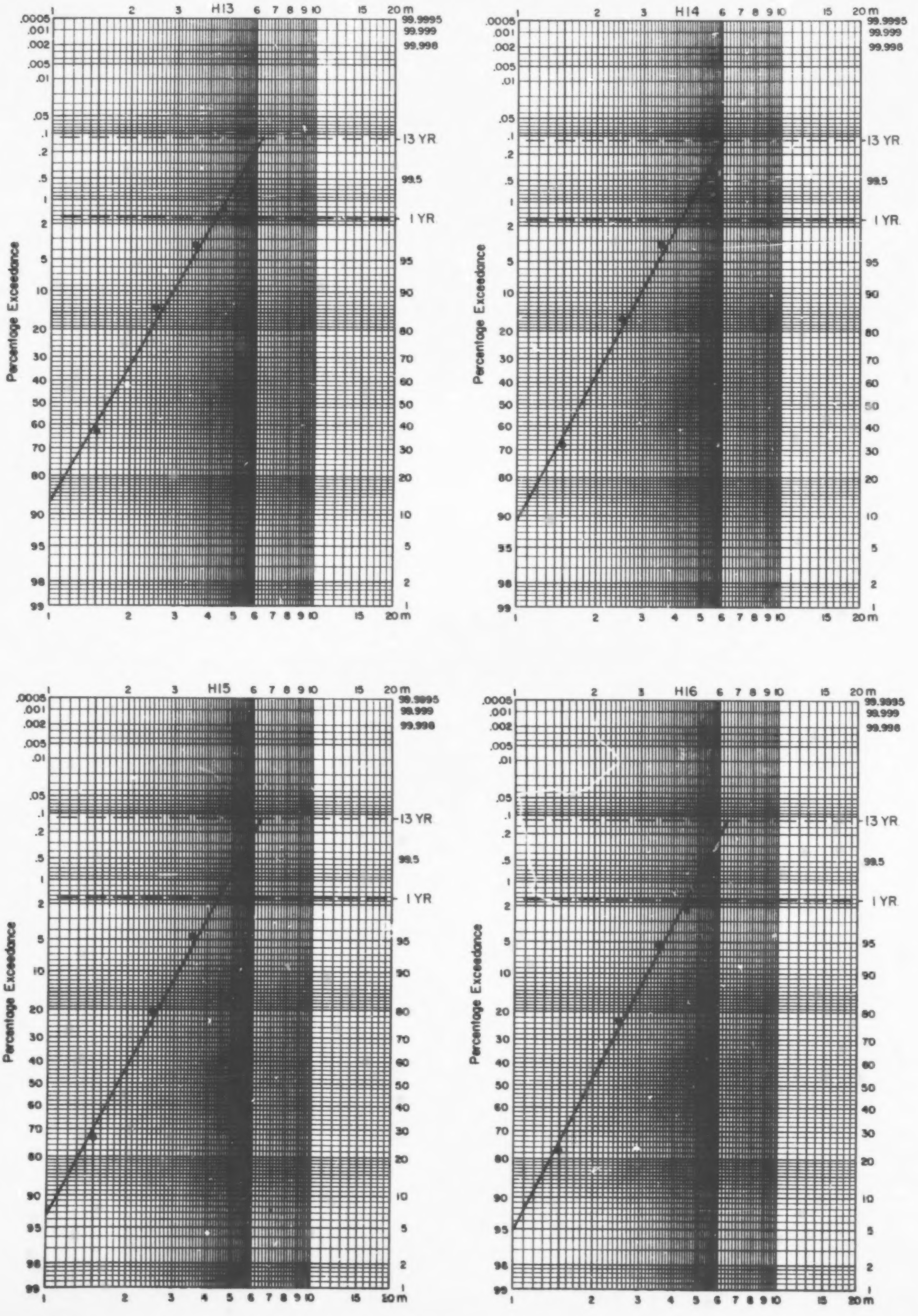


Figure 8v. Monthly Wave Height Exceedance Distribution for August

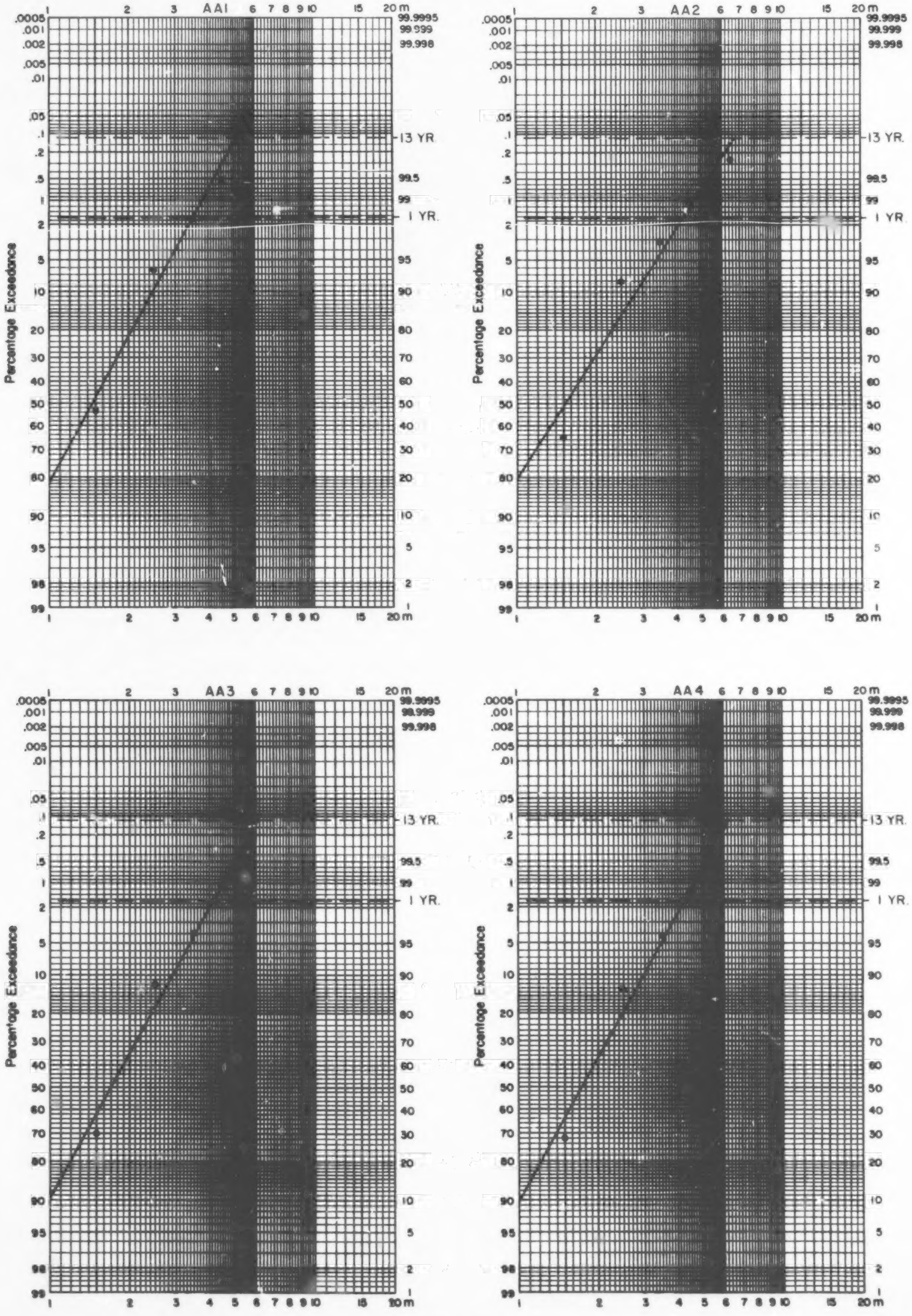


Figure 9a. Monthly Wave Height Exceedance Distribution for September

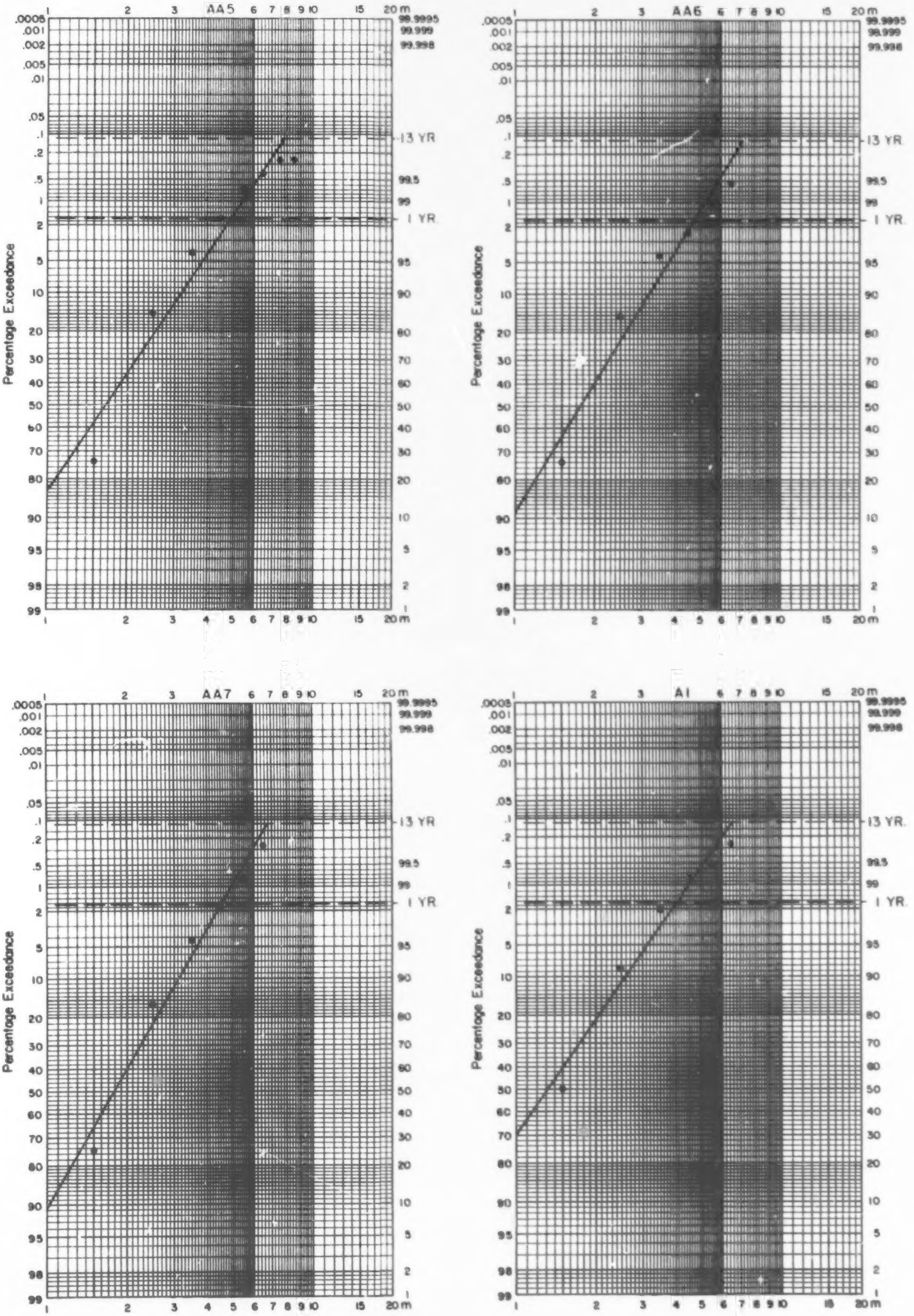


Figure 9b. Monthly Wave Height Exceedance Distribution for September

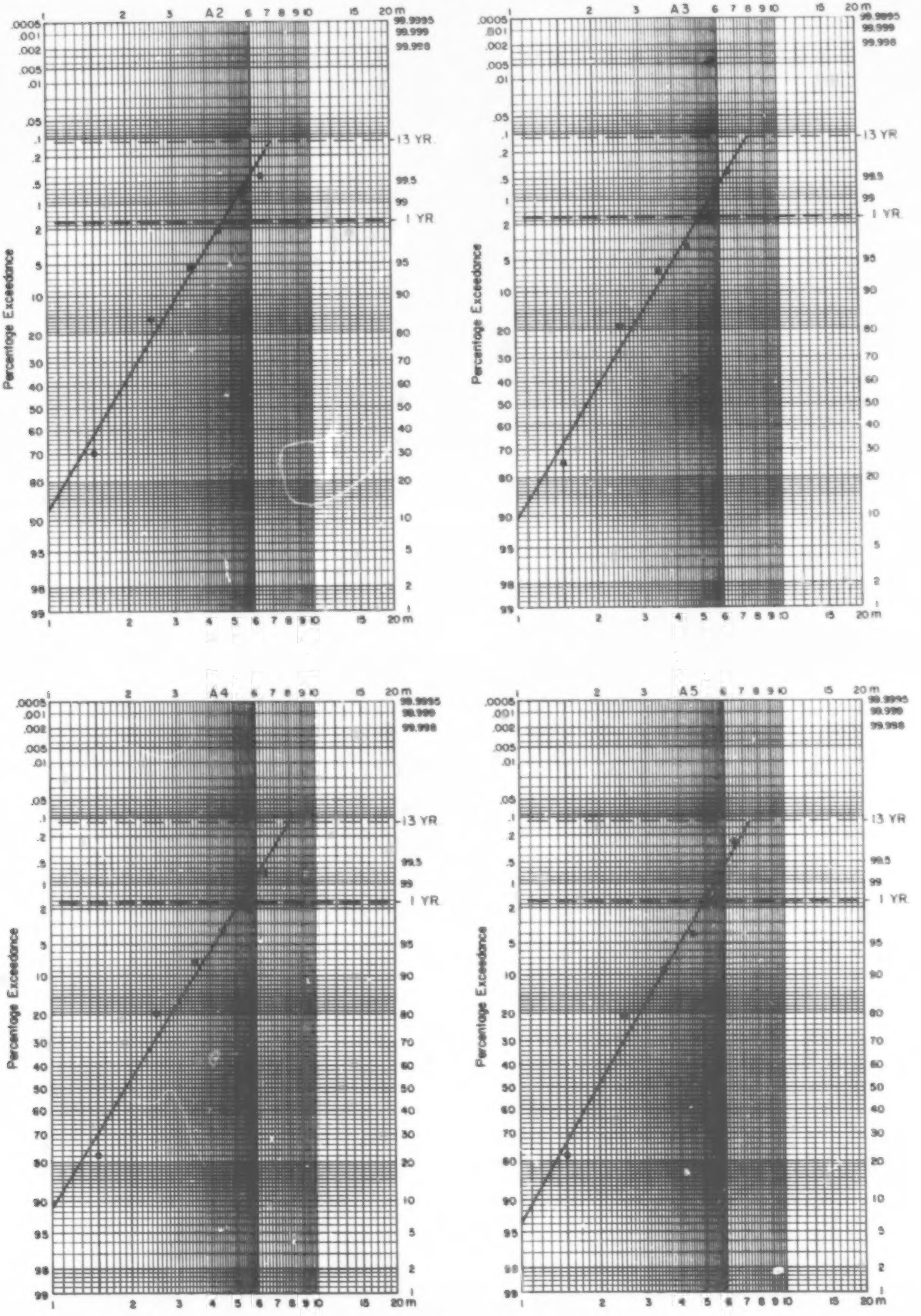
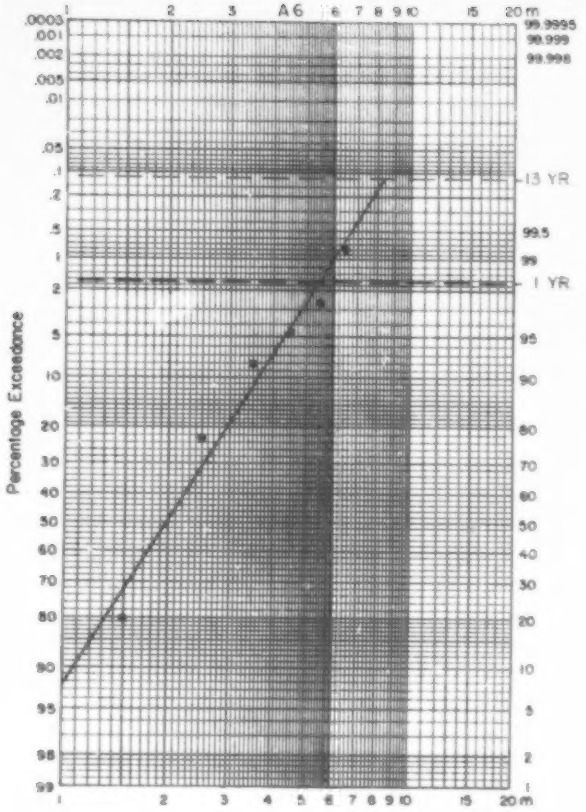
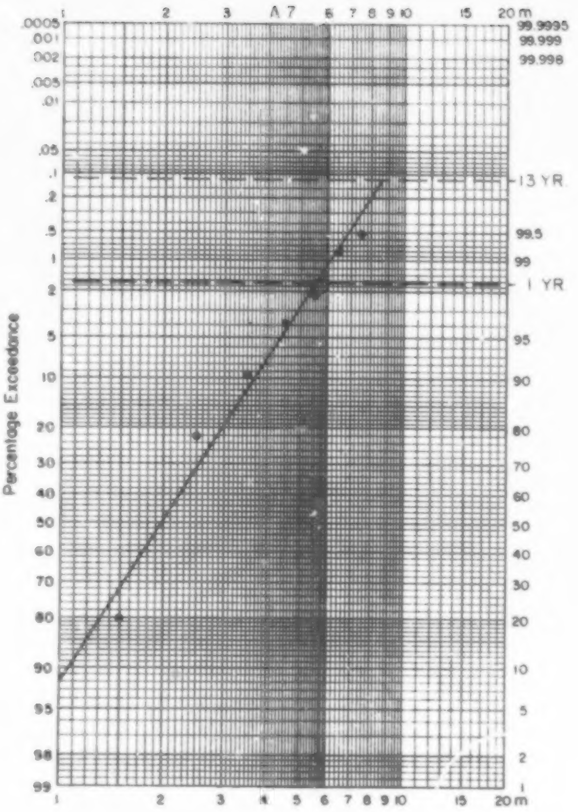
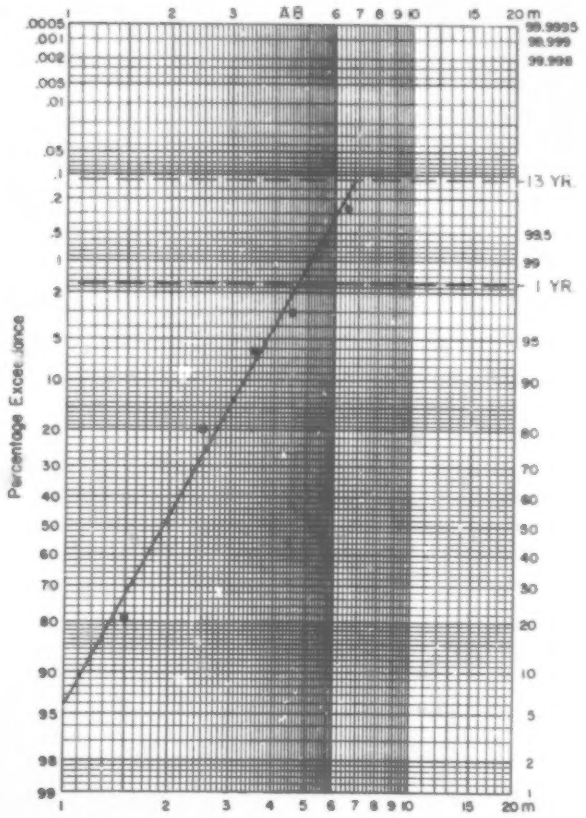


Figure 9c. Monthly Wave Height Exceedance Distribution for September







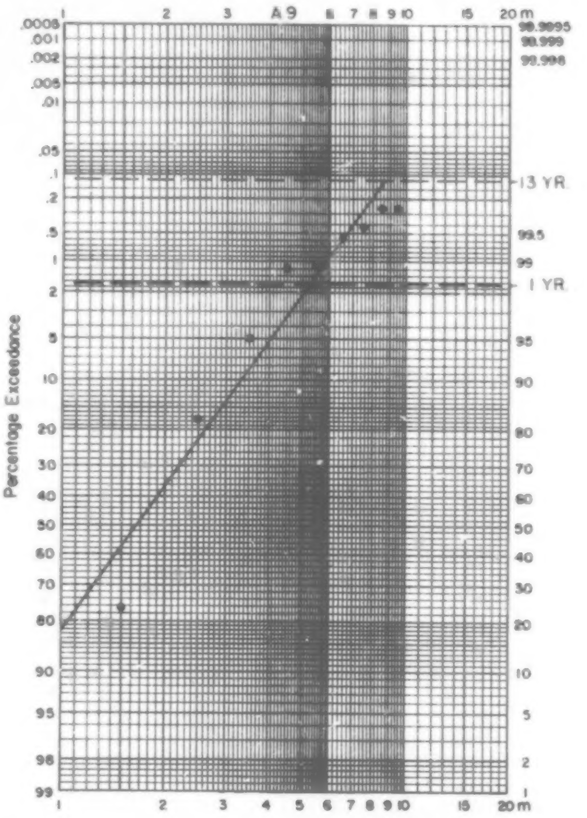


Figure 9a. Monthly Wave Height Exceedance Distribution for September

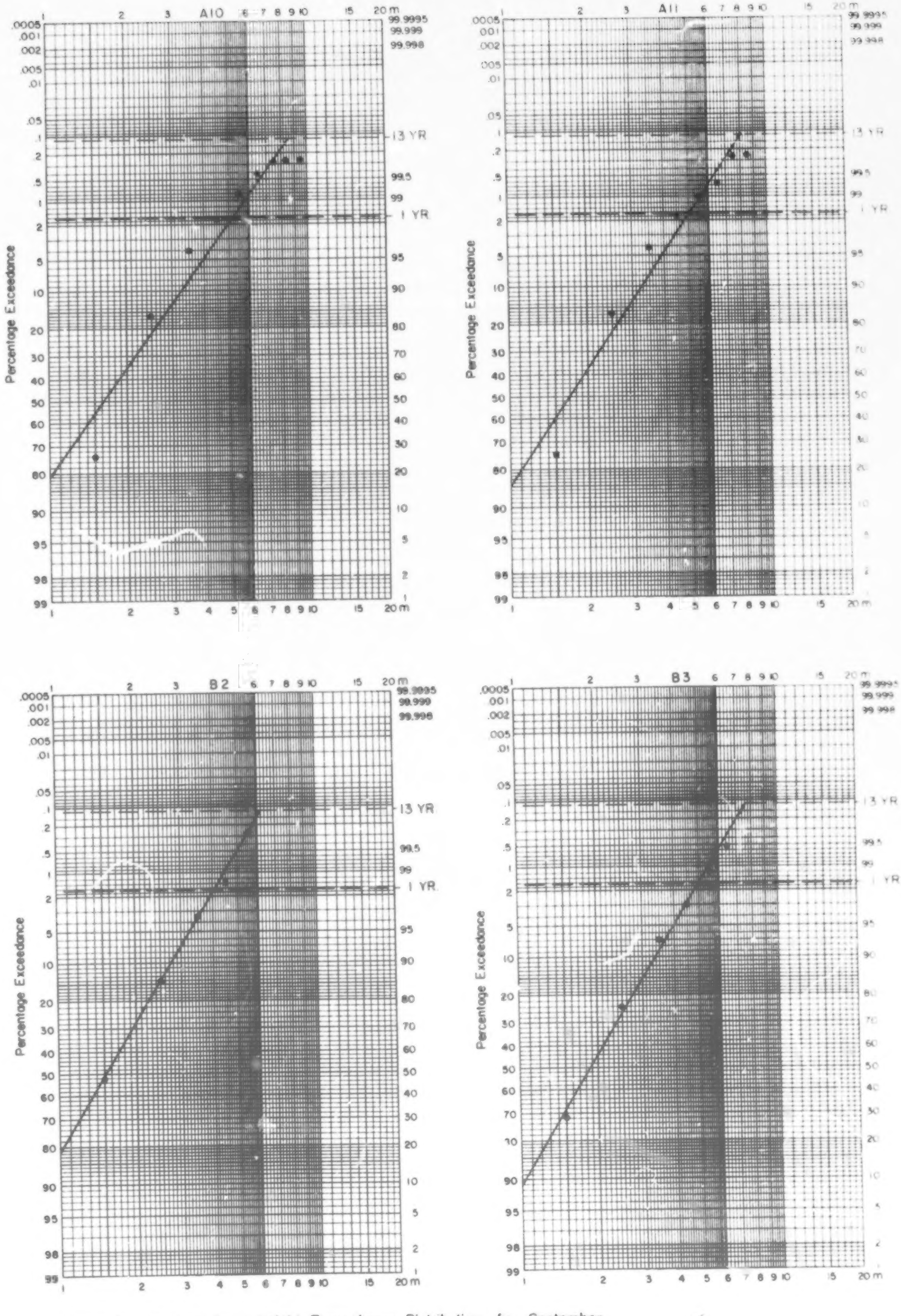


Figure 9e. Monthly Wave Height Exceedance Distribution for September

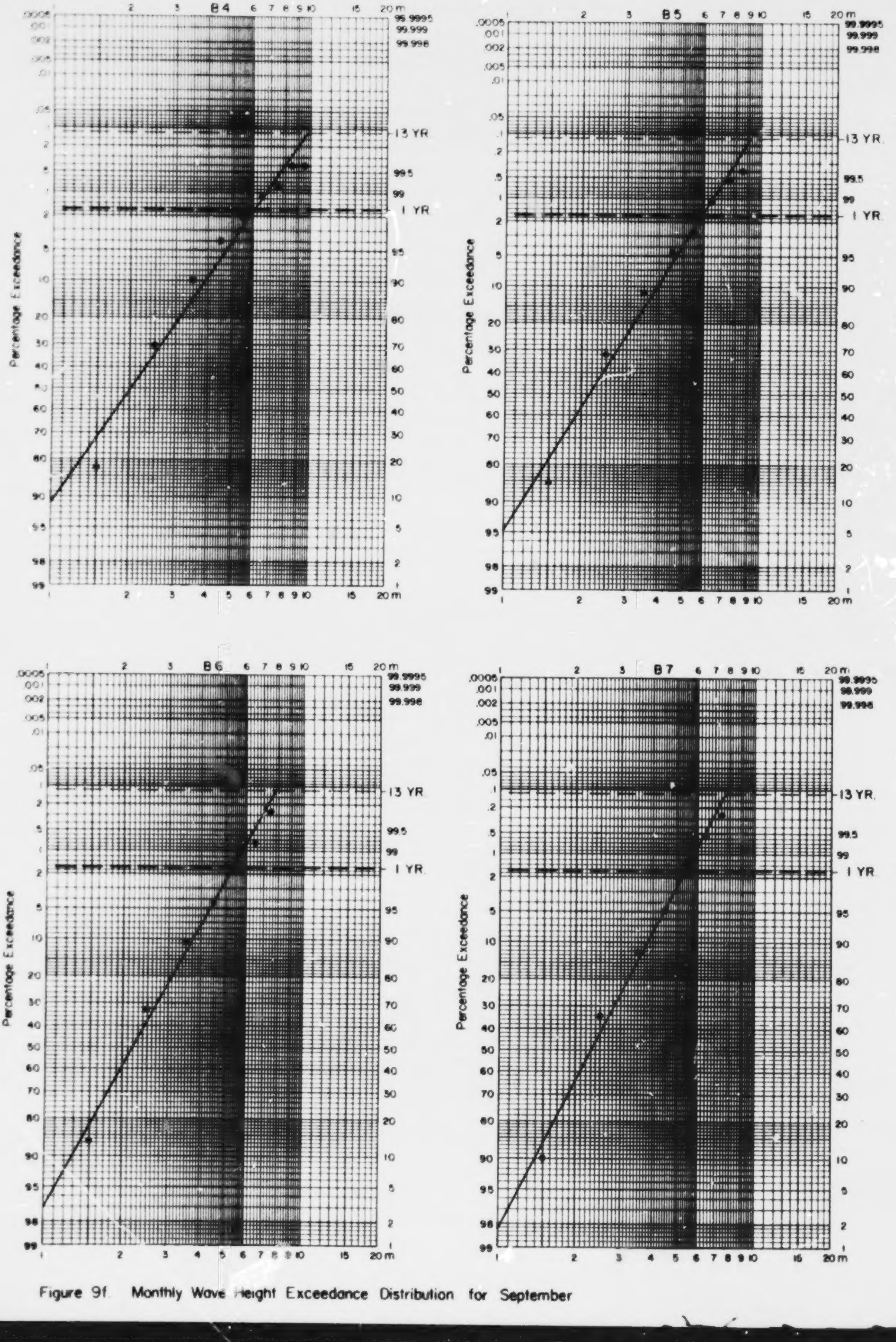


Figure 9f. Monthly Wave Height Exceedance Distribution for September

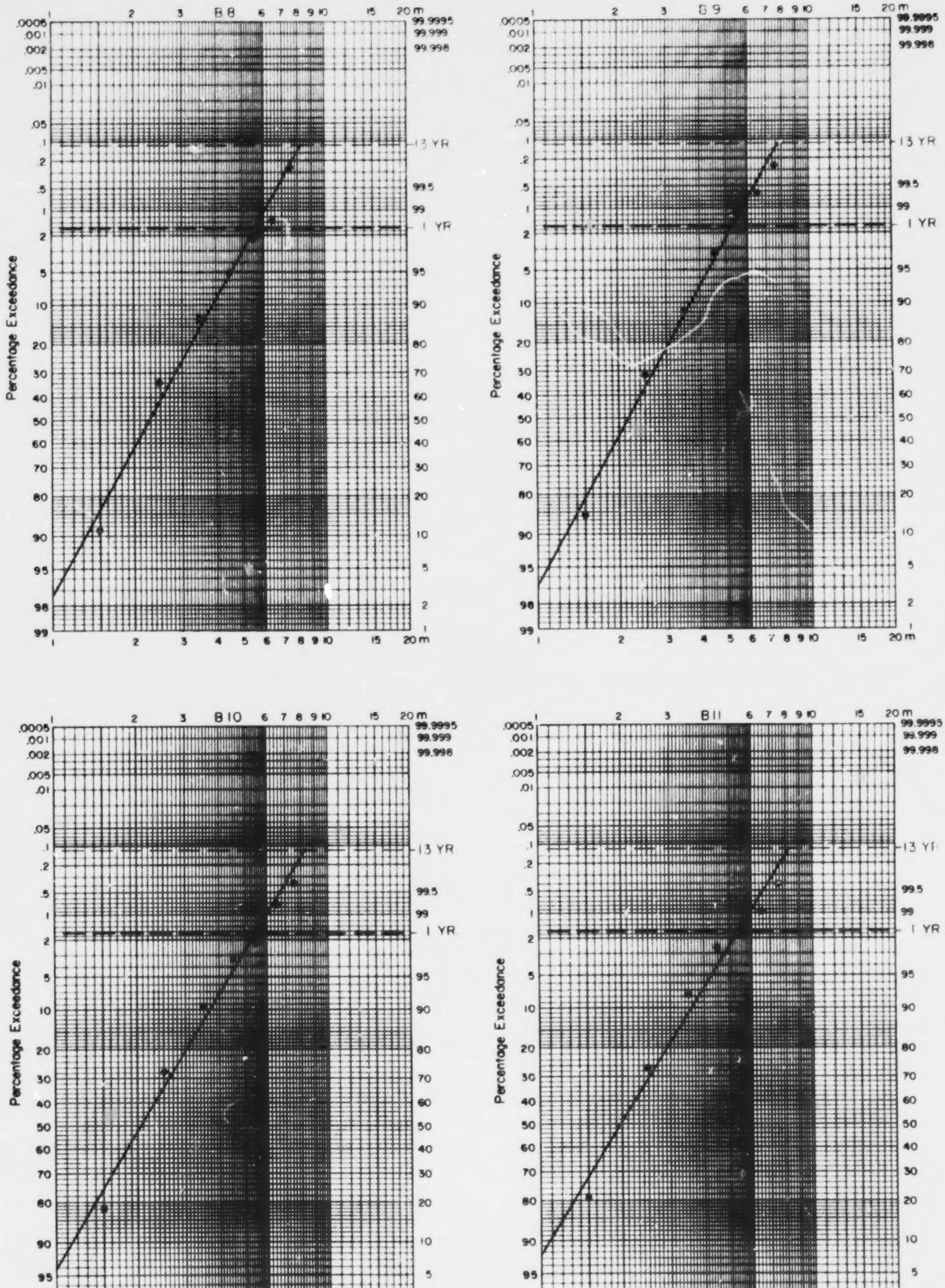


Figure 9g. Monthly Wave Height Exceedance Distribution for September

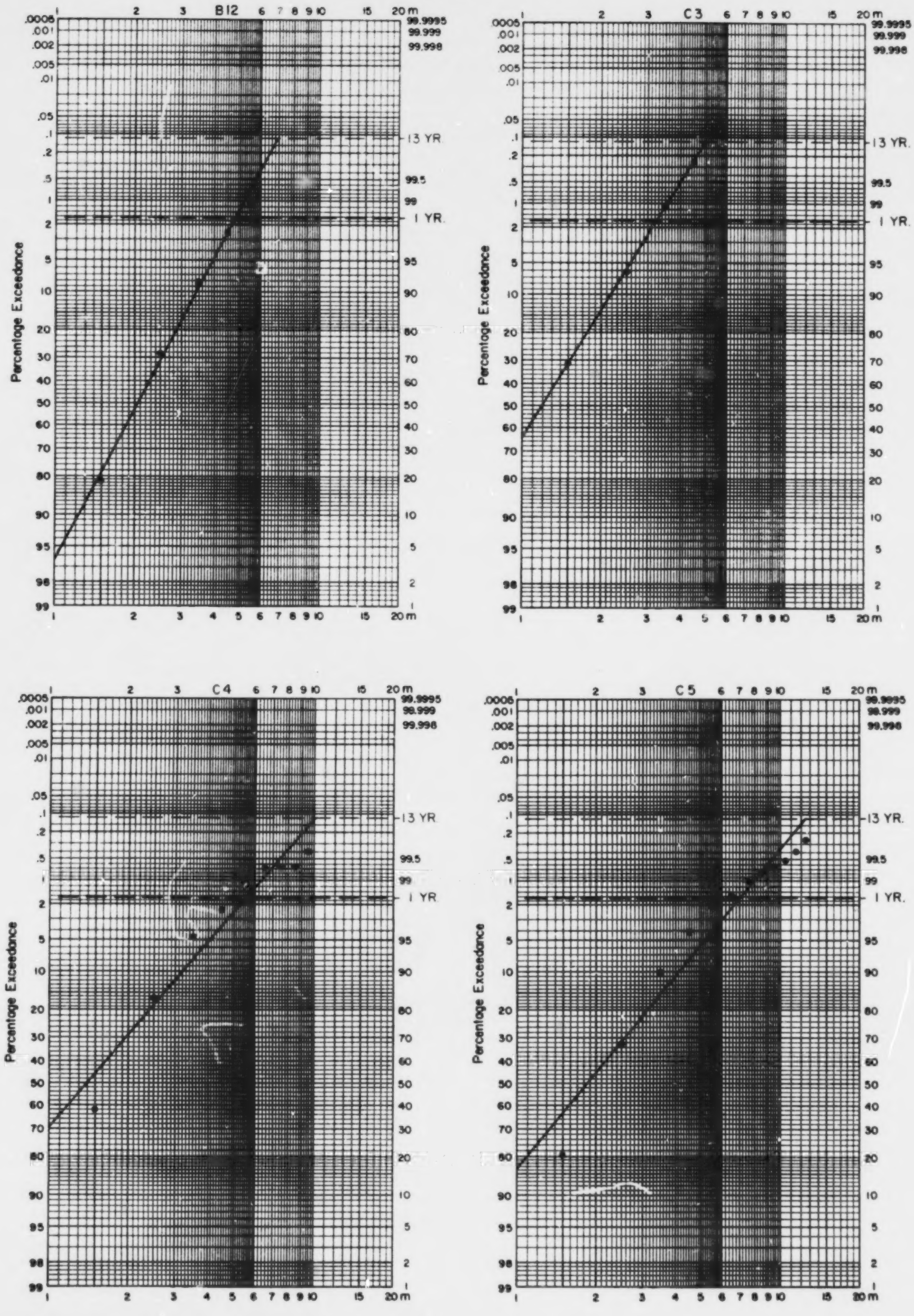


Figure 9h. Monthly Wave Height Exceedance Distribution for September

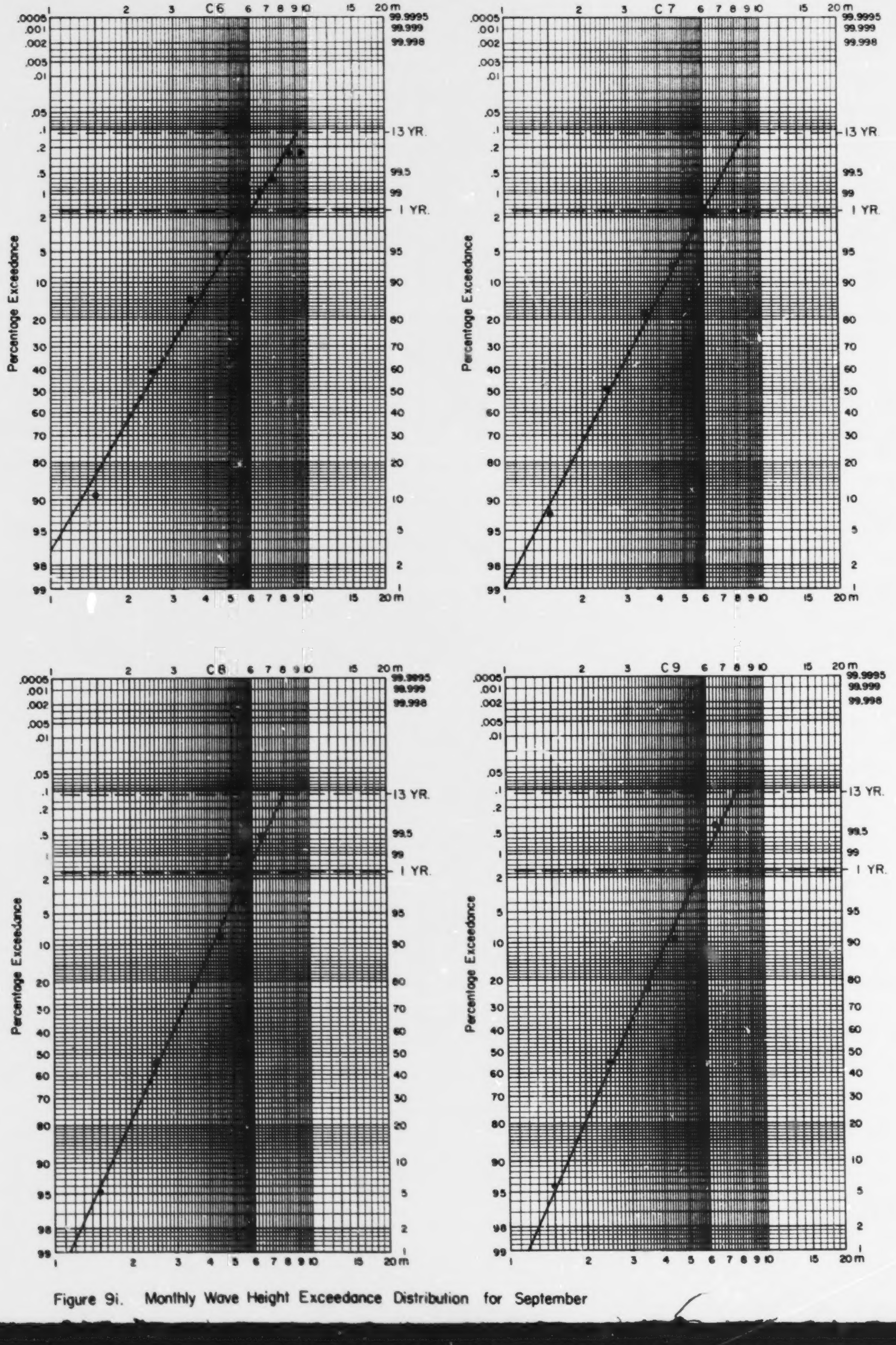
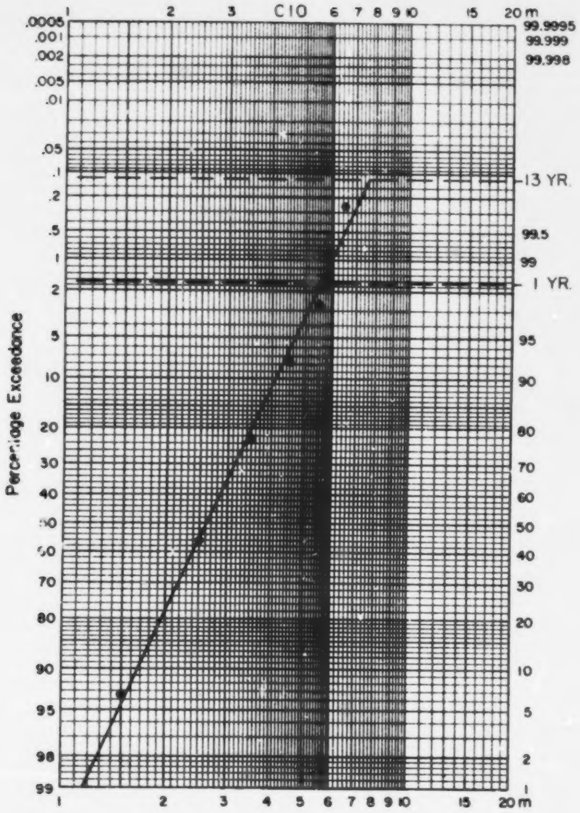
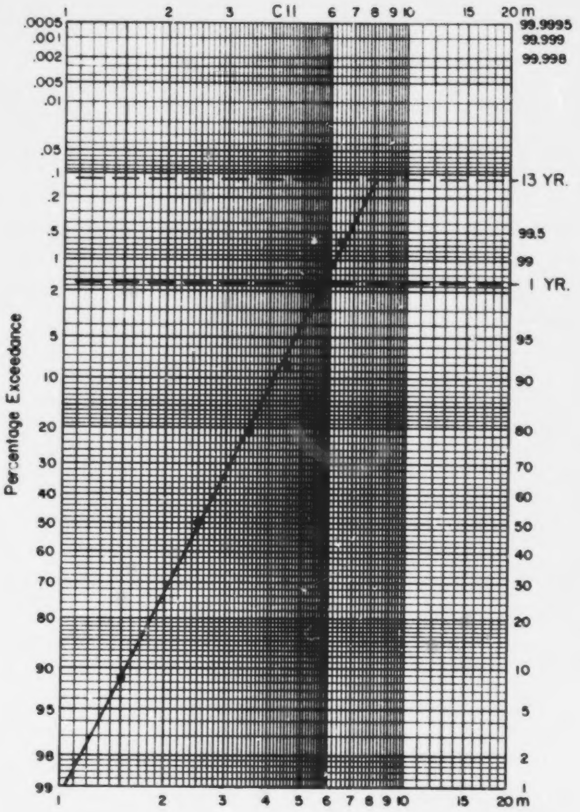
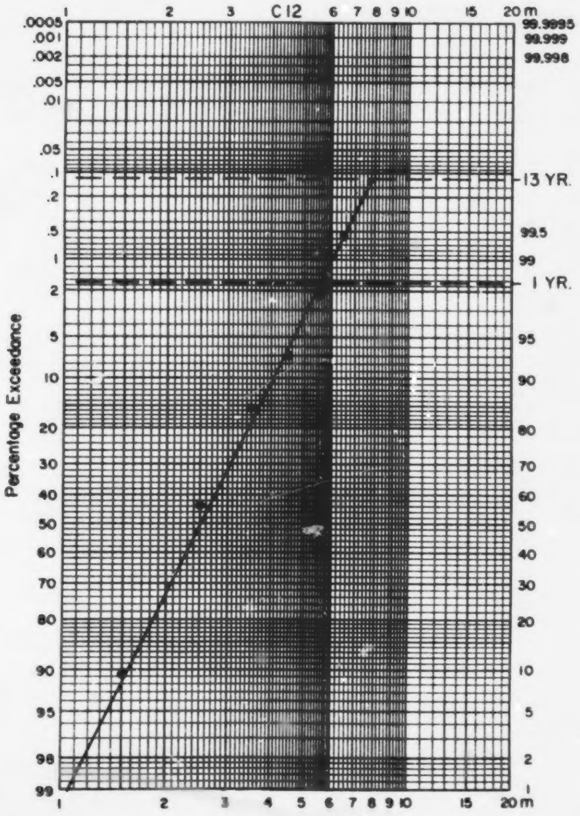


Figure 9i. Monthly Wave Height Exceedance Distribution for September







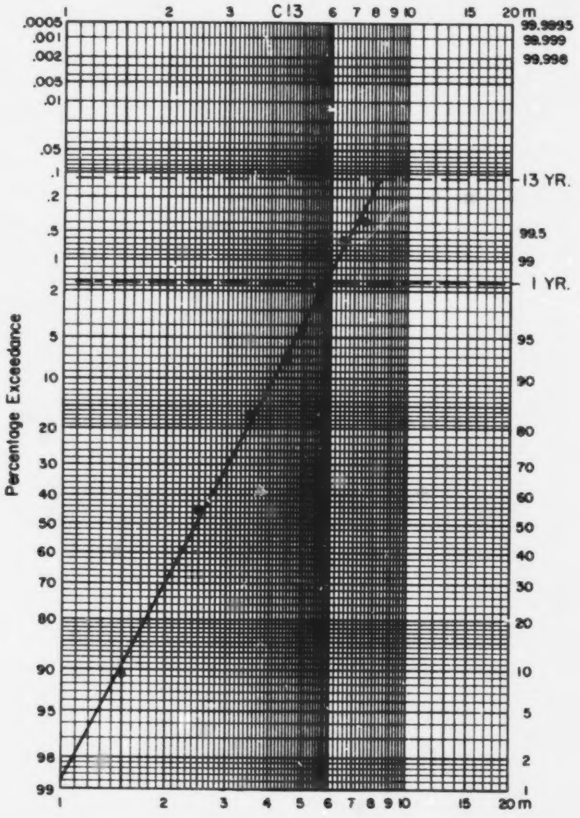


Figure 9j. Monthly Wave Height Exceedance Distribution for September

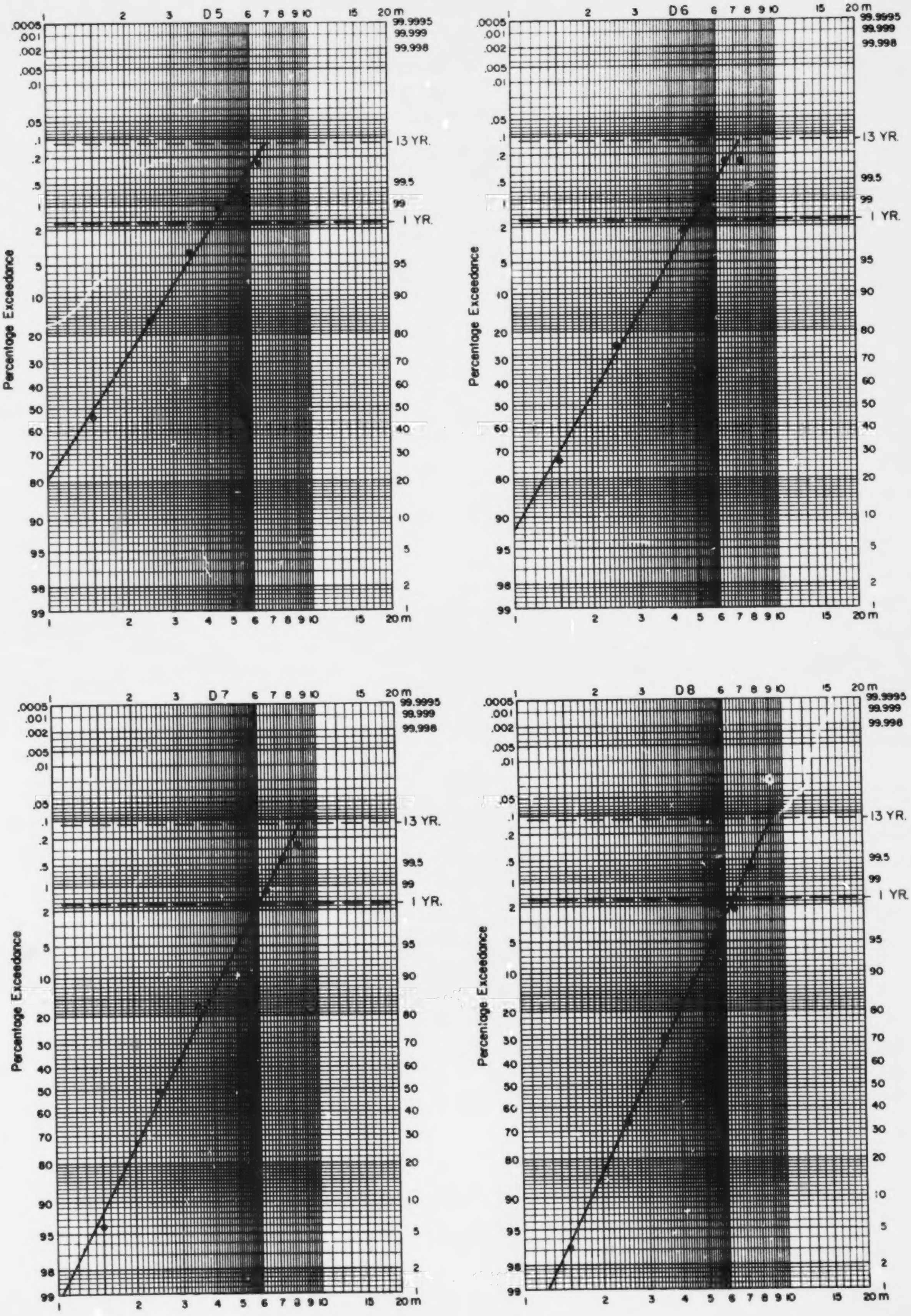


Figure 9k. Monthly Wave Height Exceedance Distribution for September

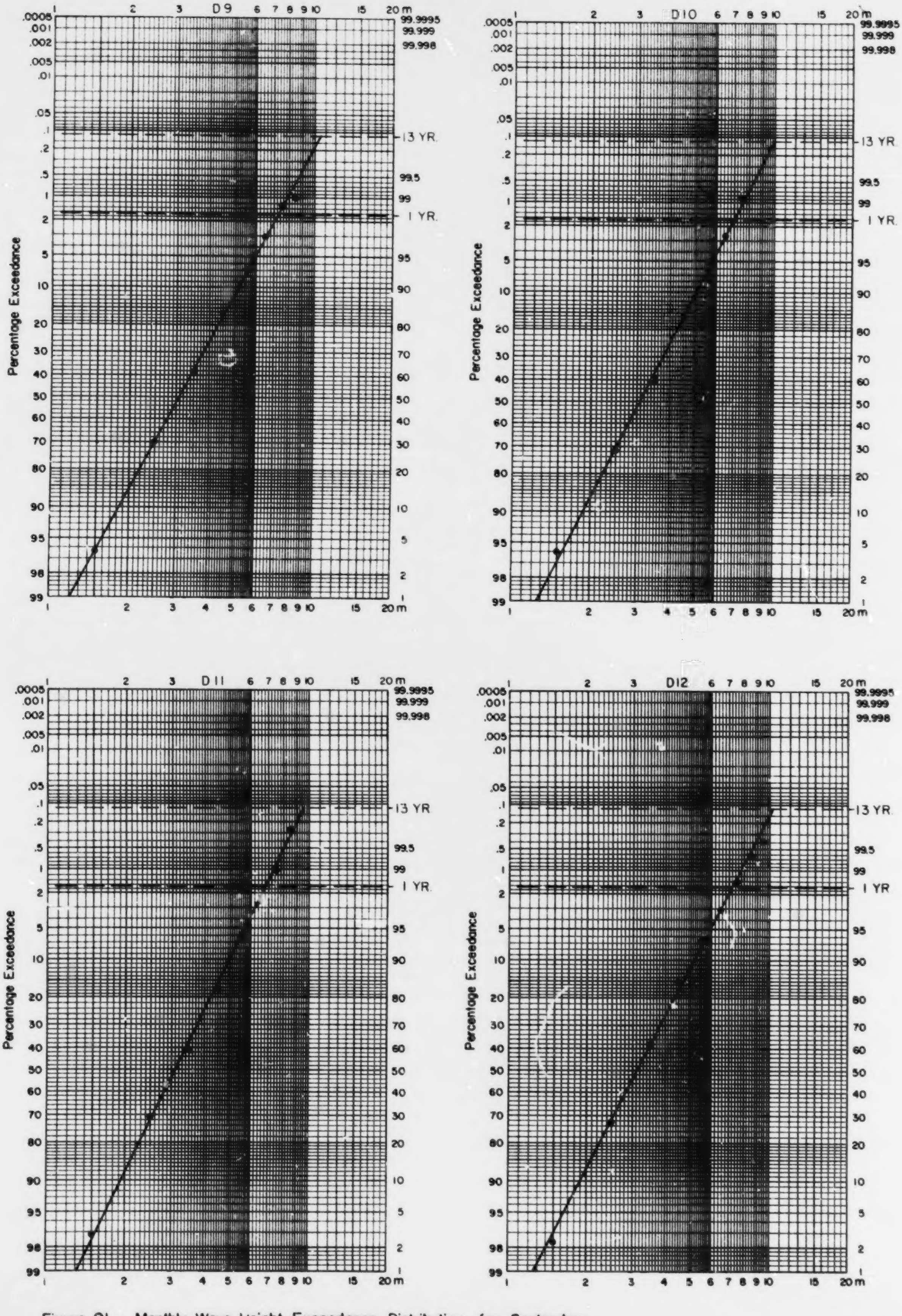


Figure 91. Monthly Wave Height Exceedance Distribution for September

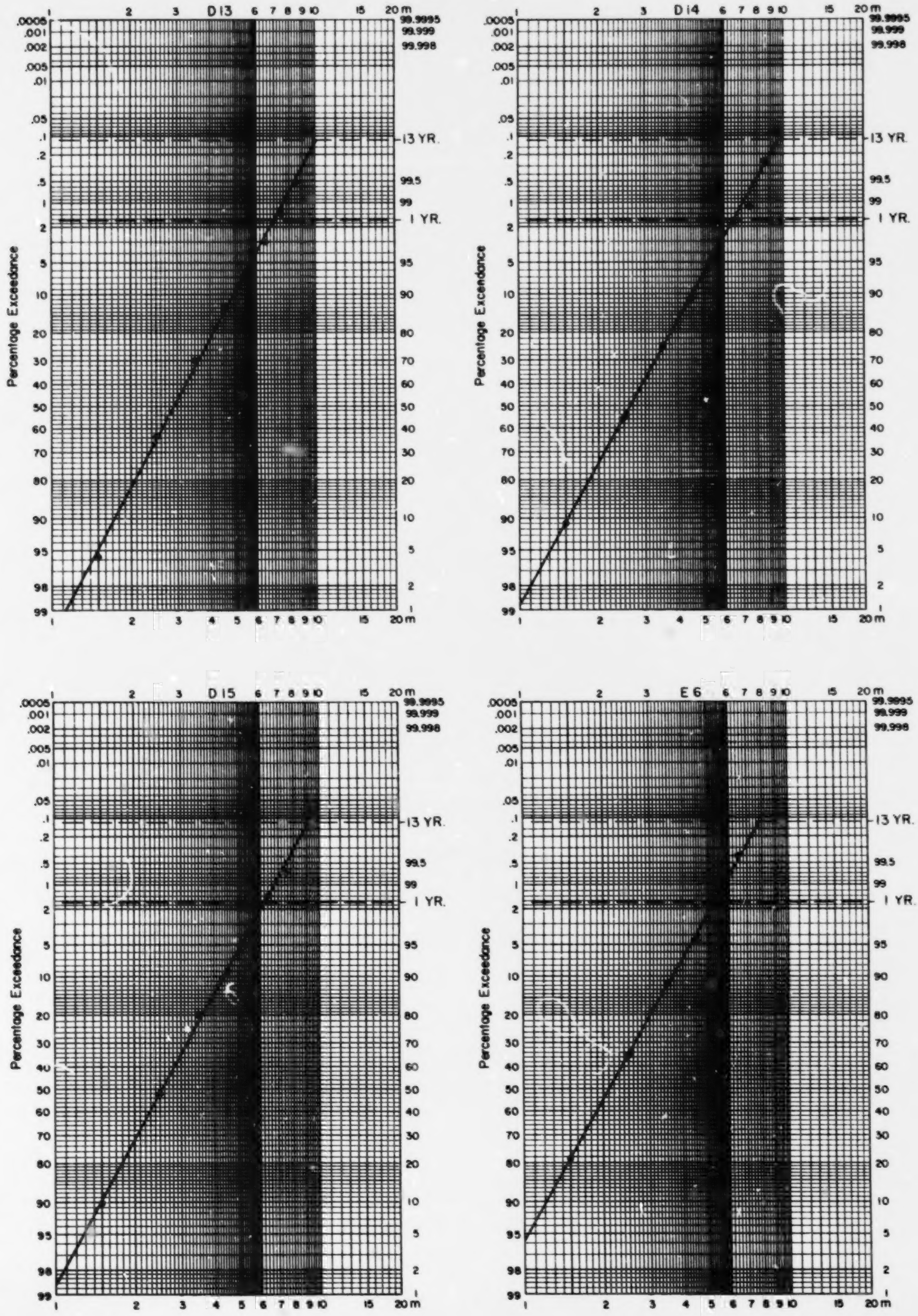


Figure 9m. Monthly Wave Height Exceedance Distribution for September

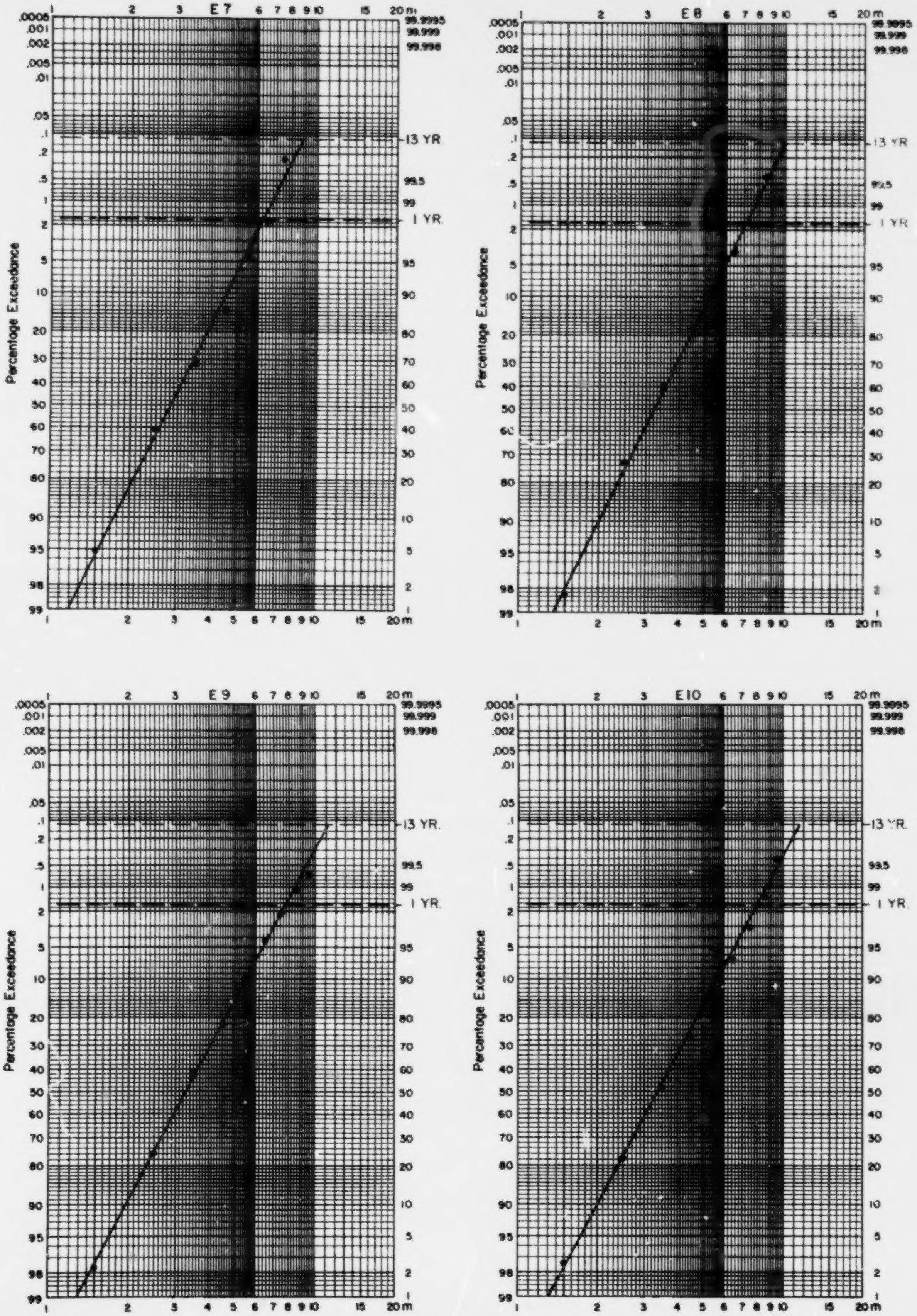


Figure 9n. Monthly Wave Height Exceedance Distribution for September

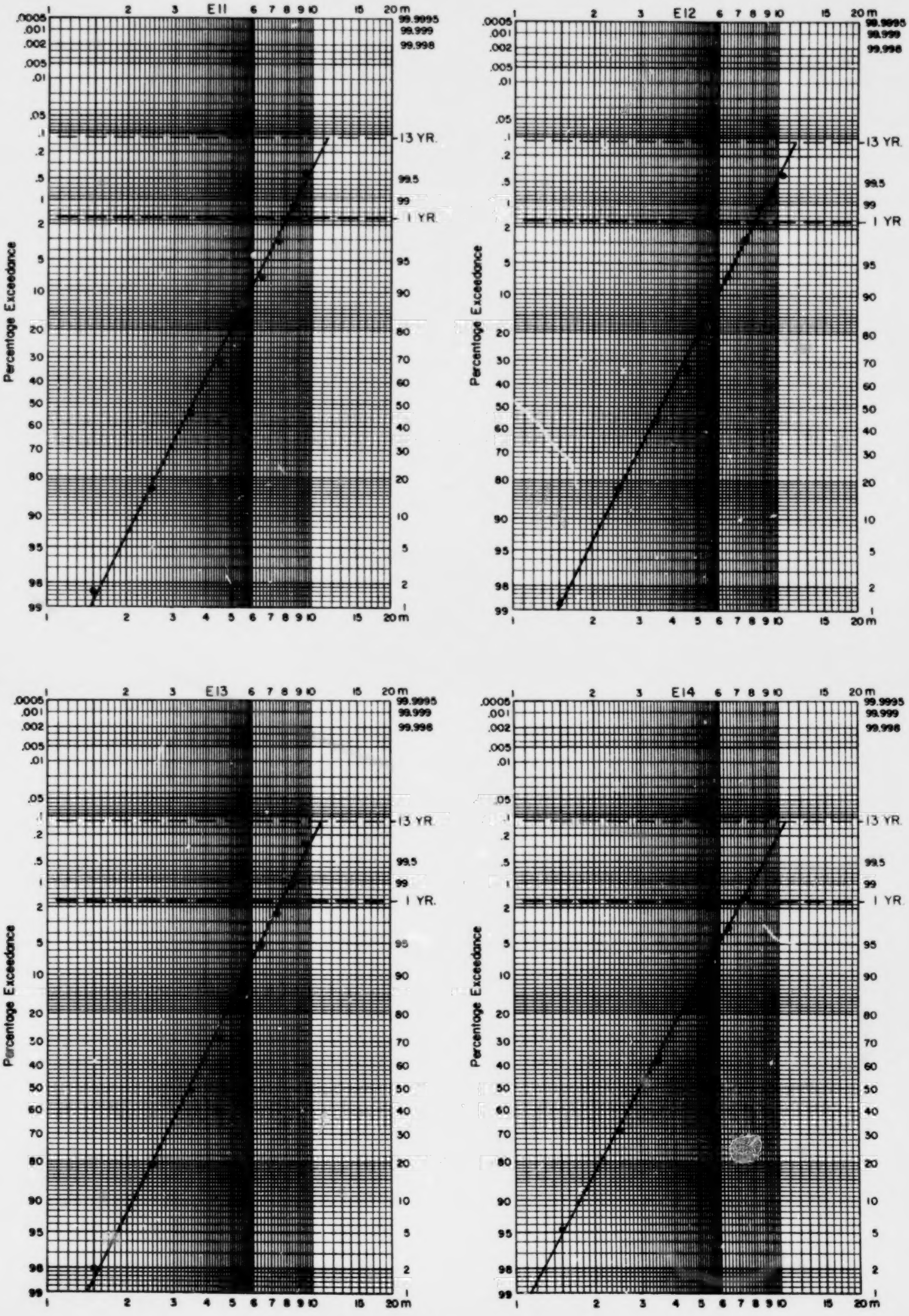
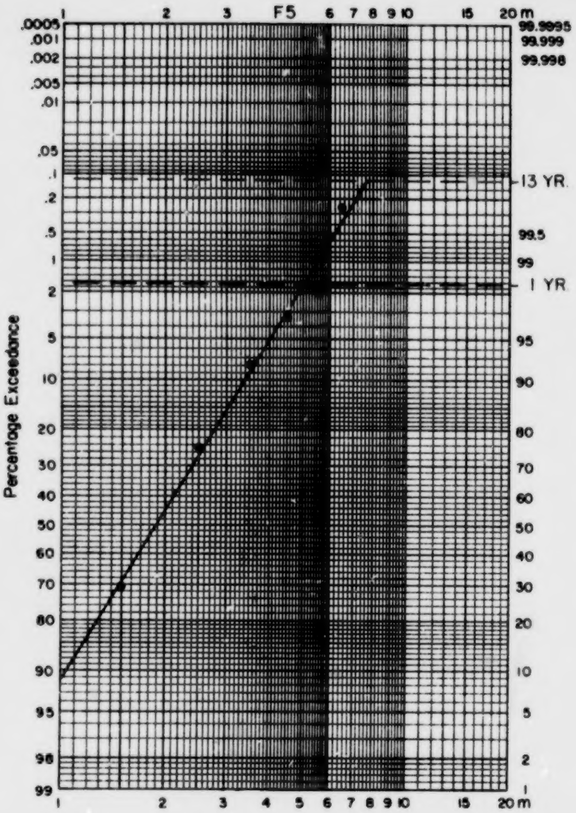
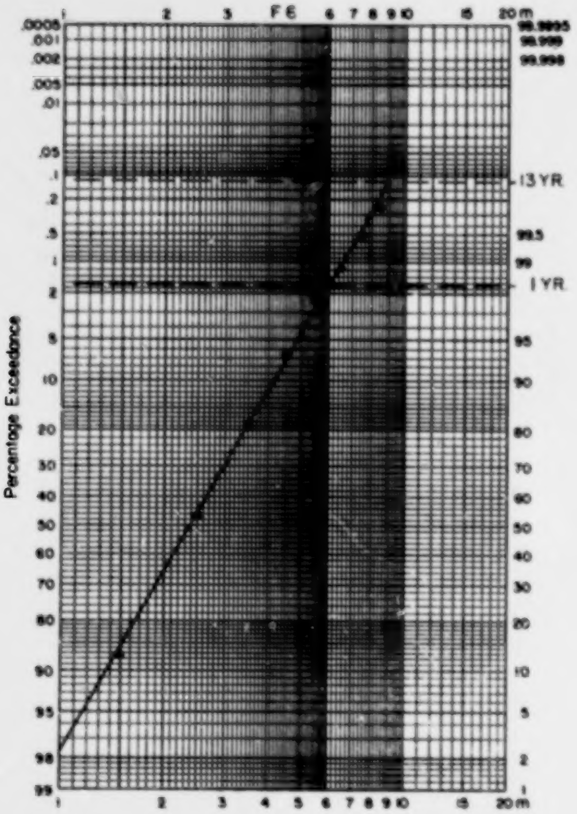
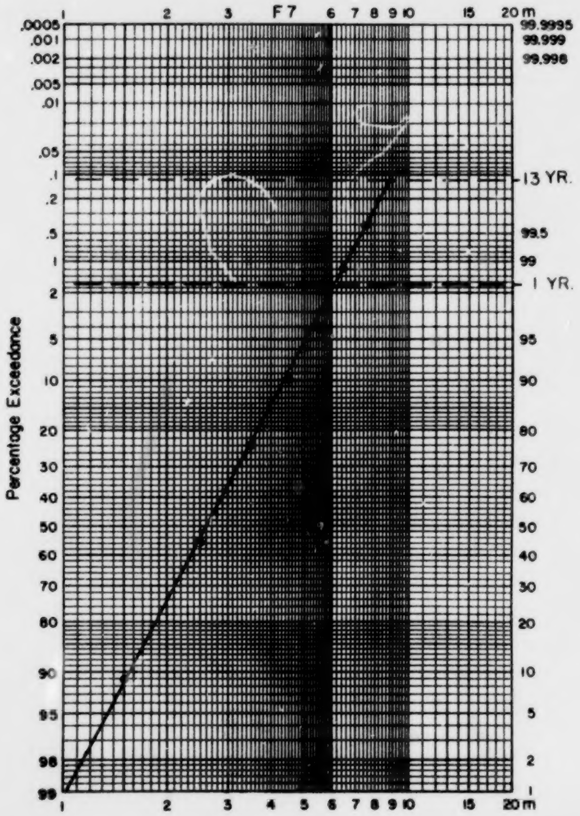


Figure 9o. Monthly Wave Height Exceedance Distribution for September







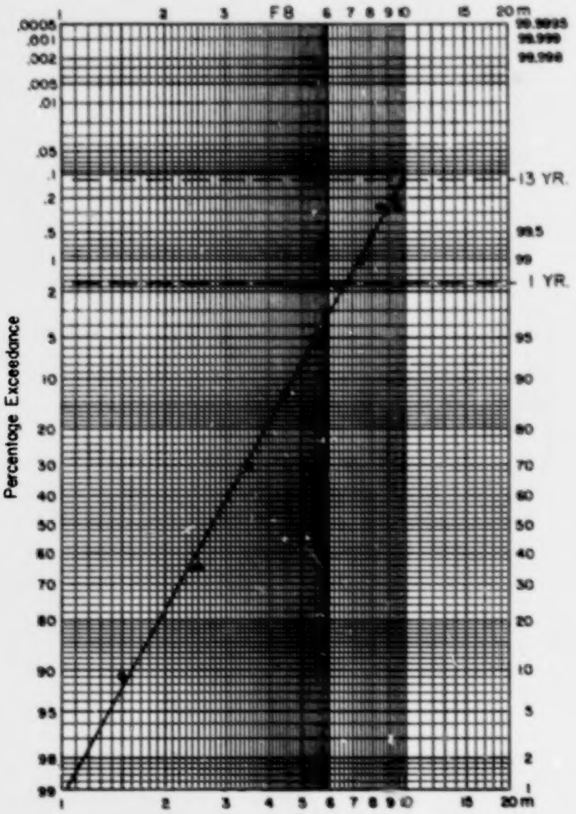


Figure 9p. Monthly Wave Height Exceedance Distribution for September

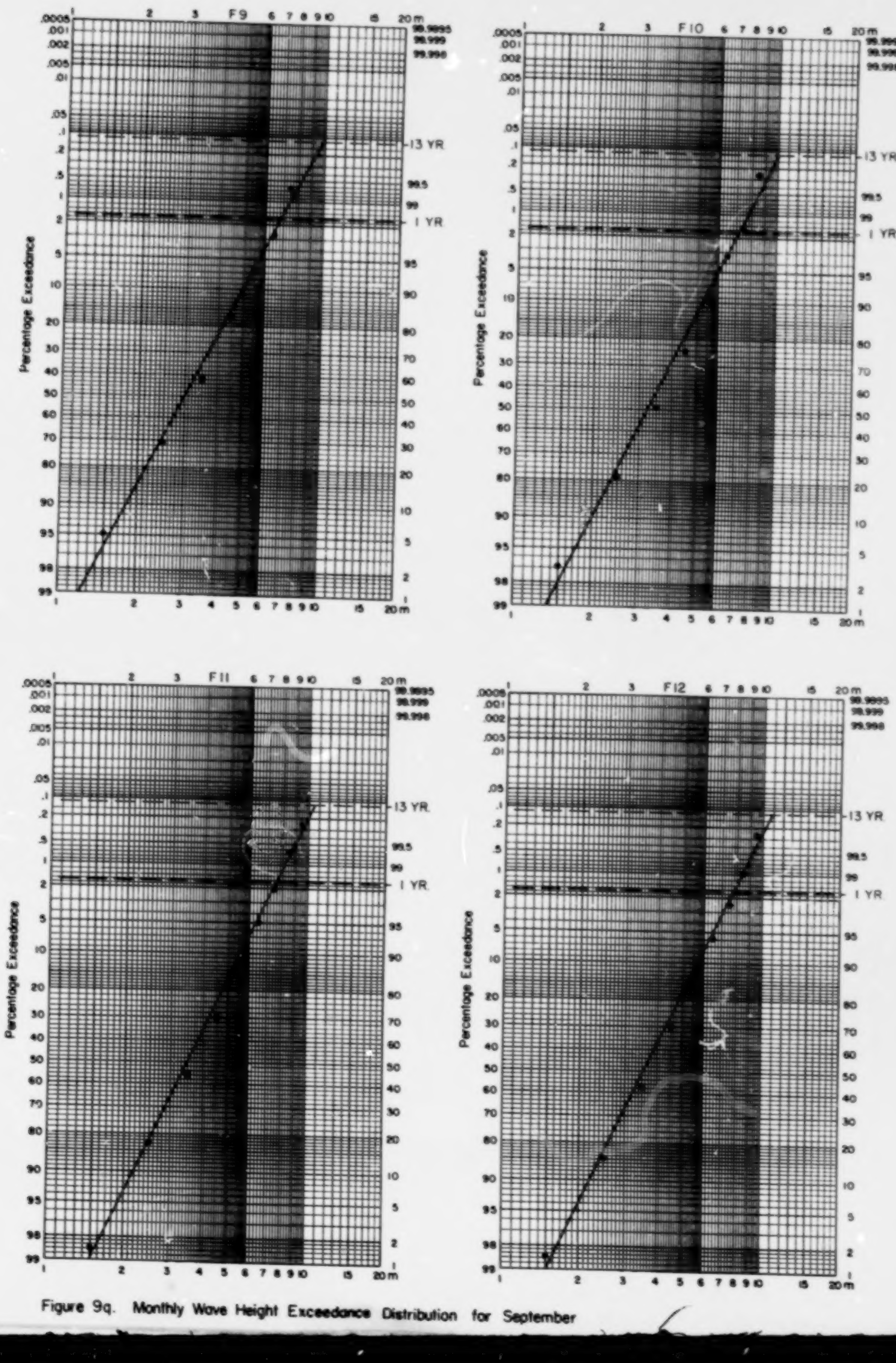


Figure 9q. Monthly Wave Height Exceedance Distribution for September

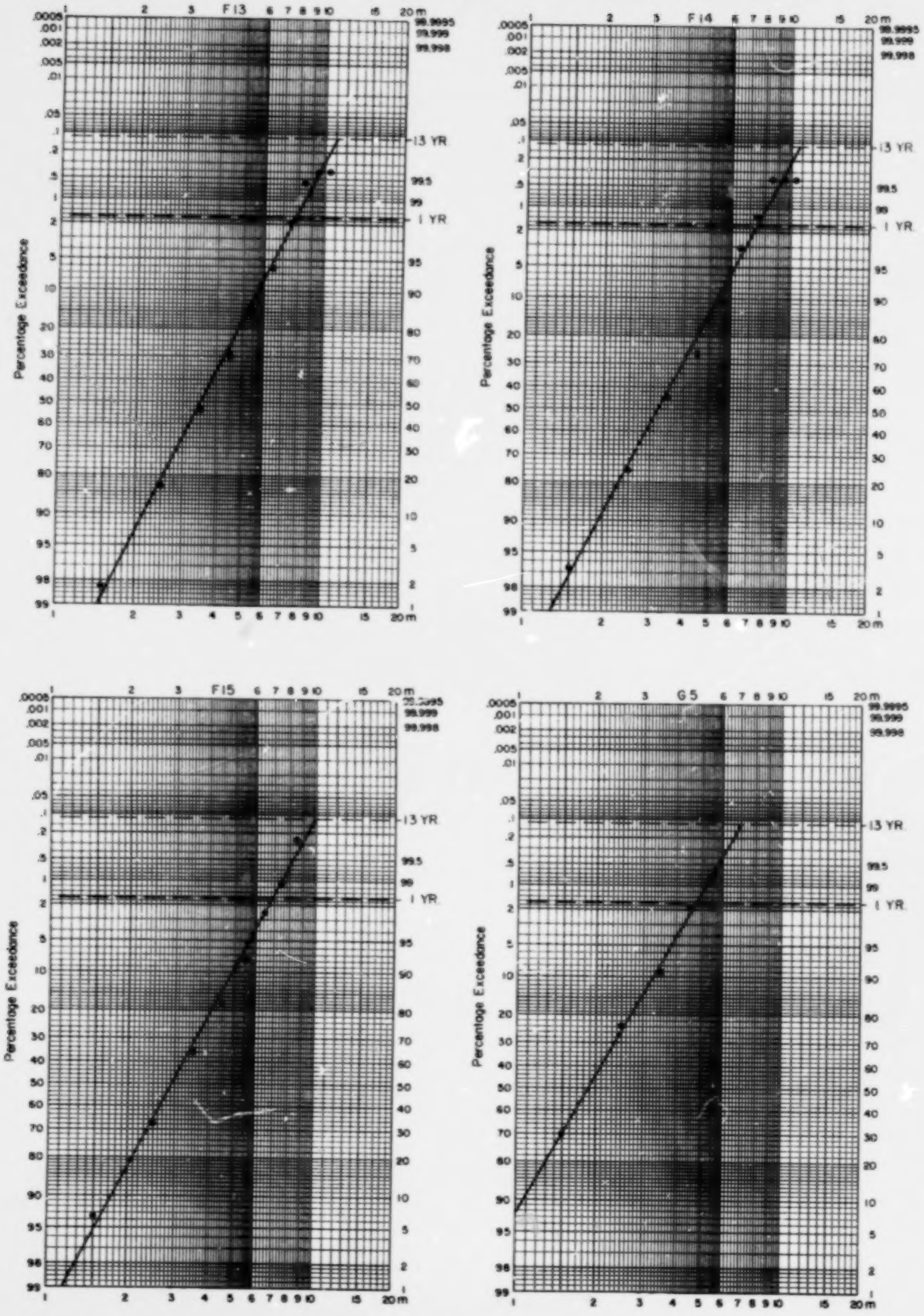


Figure 9r. Monthly Wave Height Exceedance Distribution for September

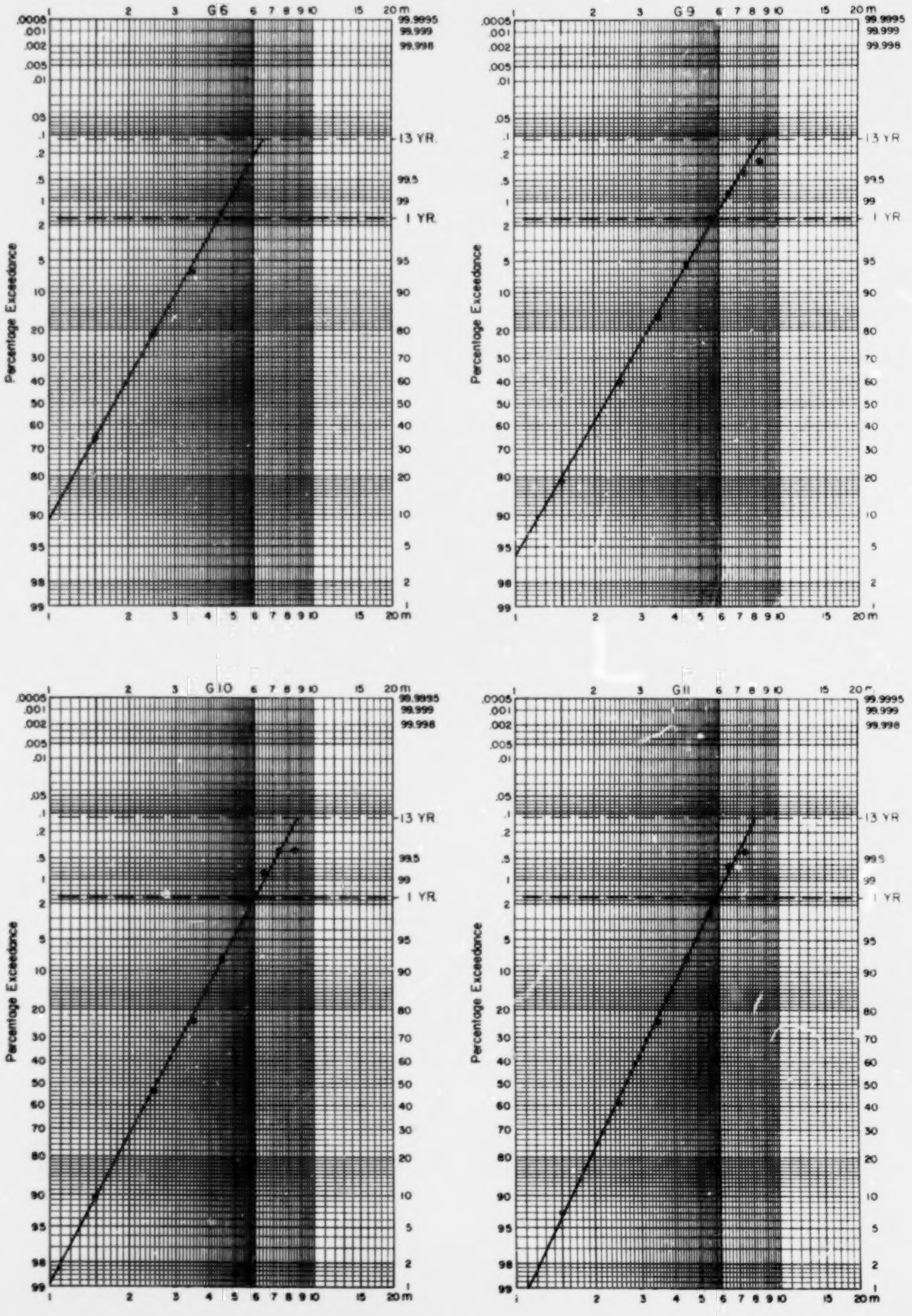


Figure 9s. Monthly Wave Height Exceedance Distribution for September

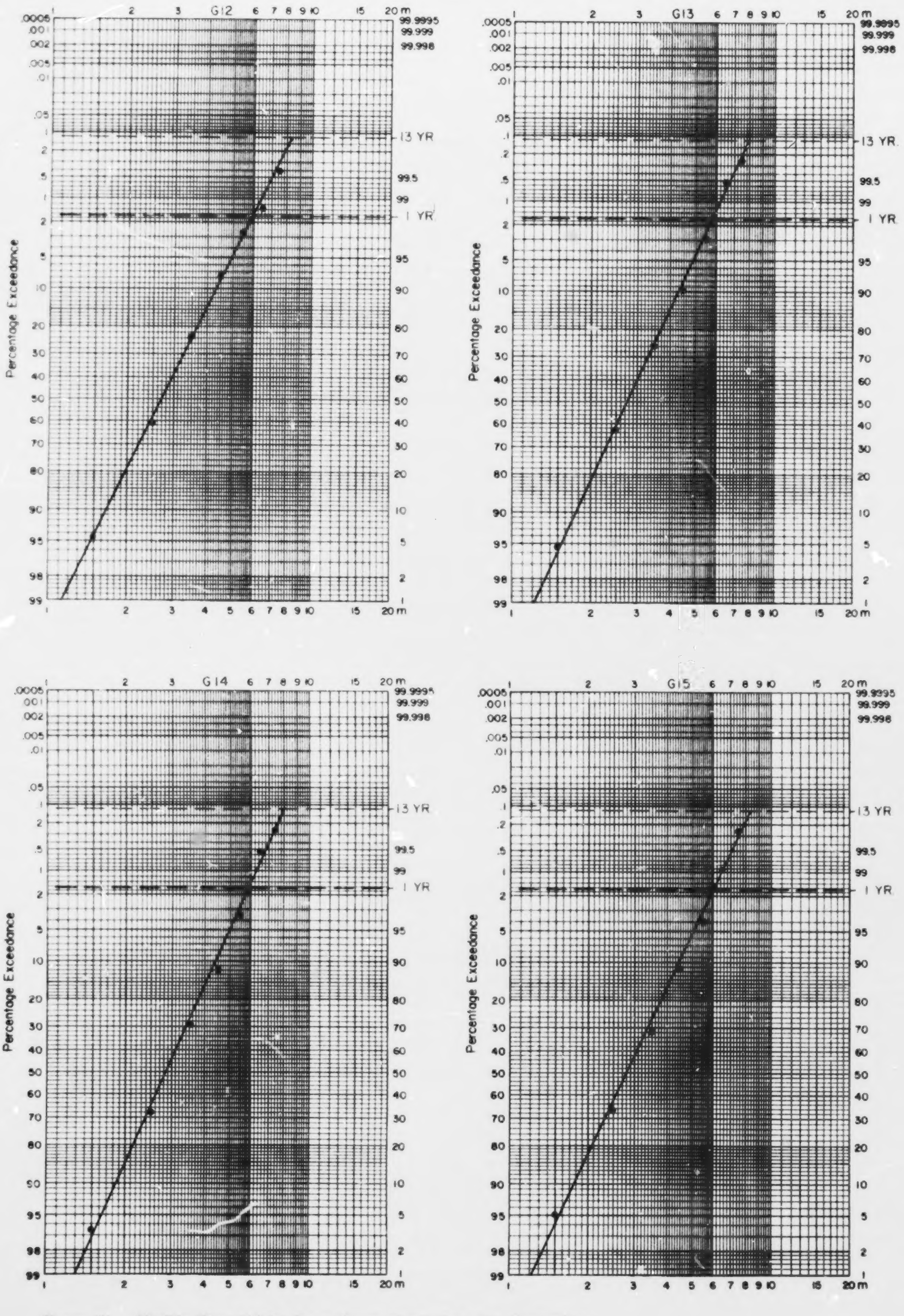


Figure 91. Monthly Wave Height Exceedance Distribution for September

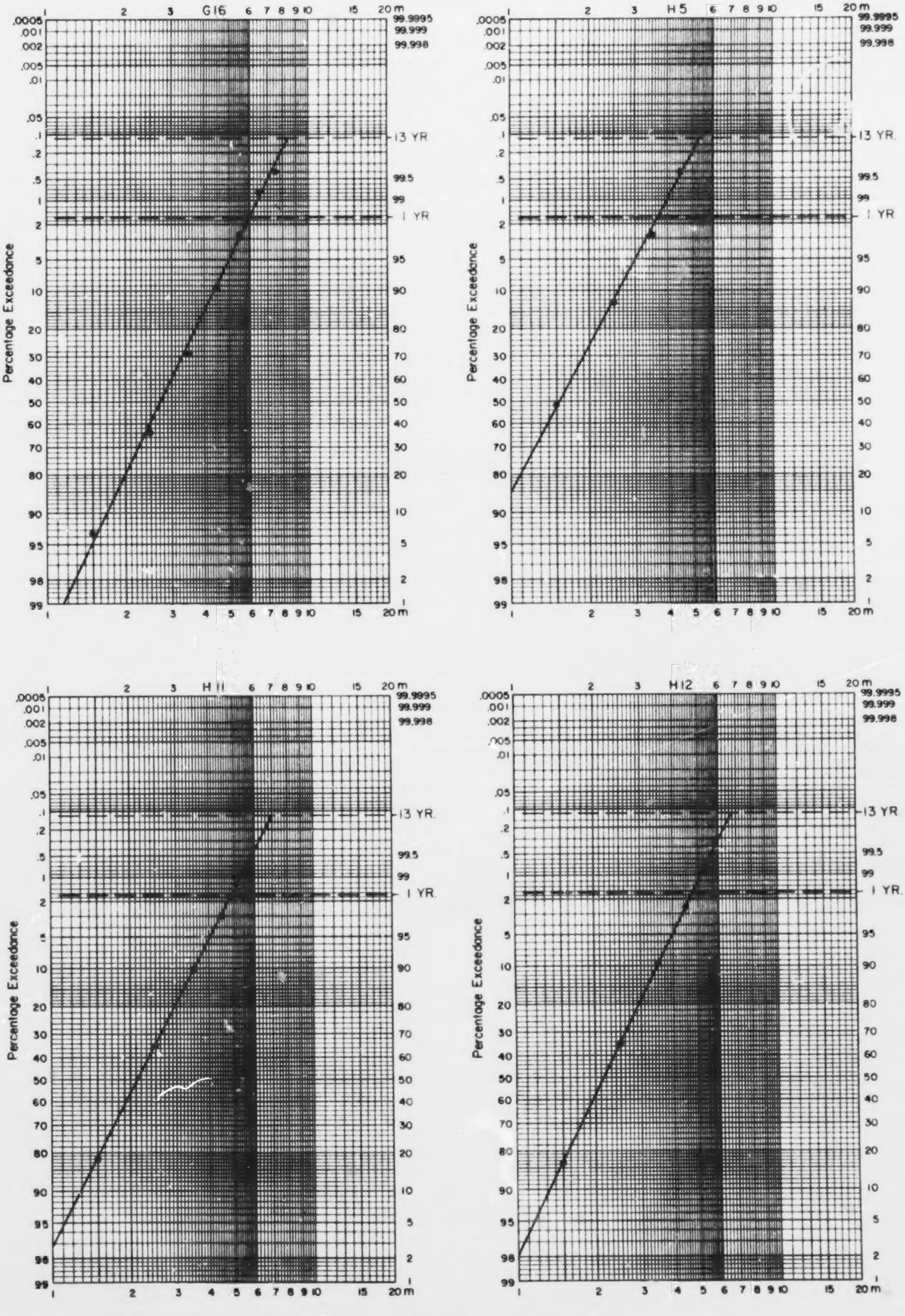


Figure 9u. Monthly Wave Height Exceedance Distribution for September

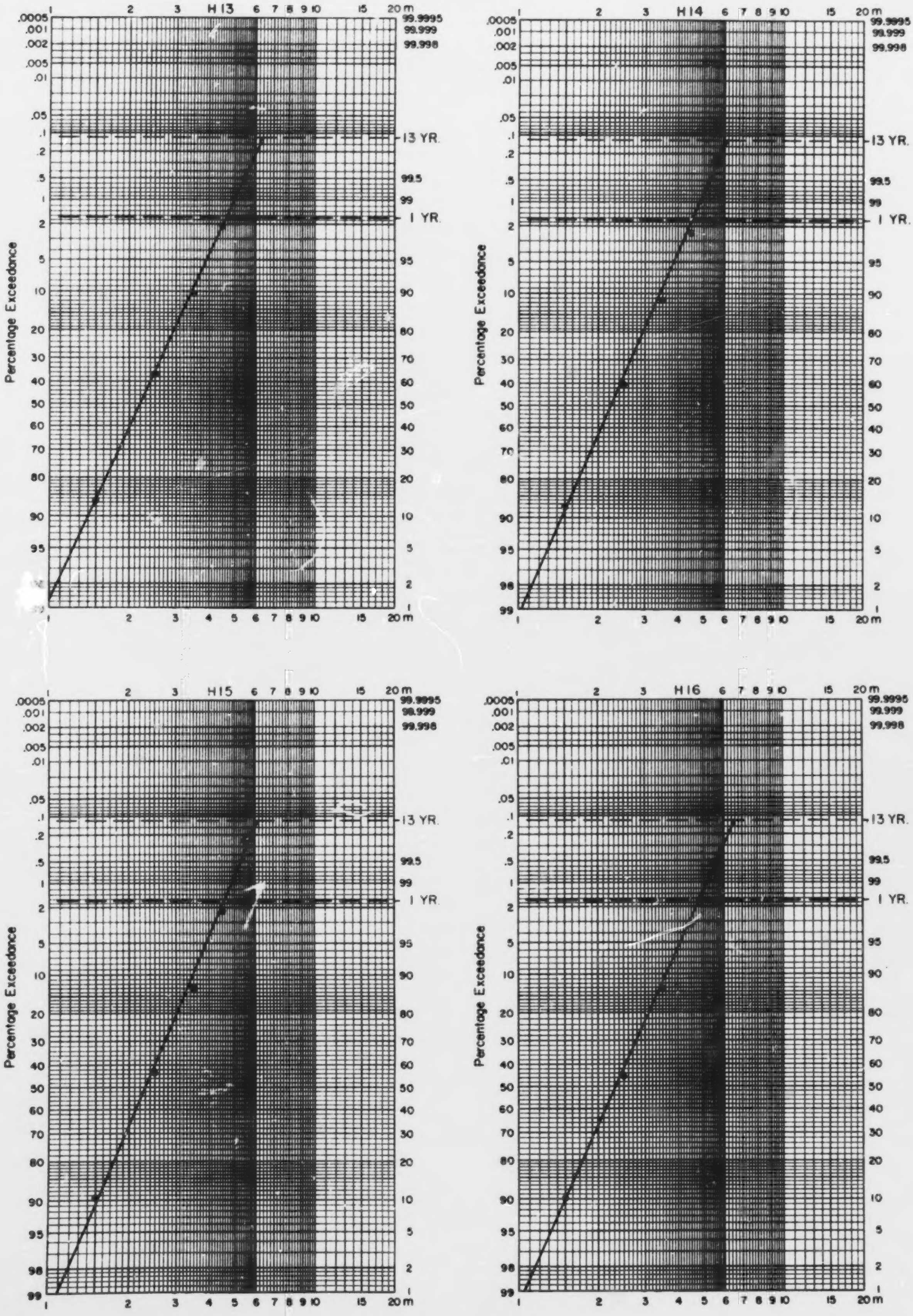


Figure 9v. Monthly Wave Height Exceedance Distribution for September

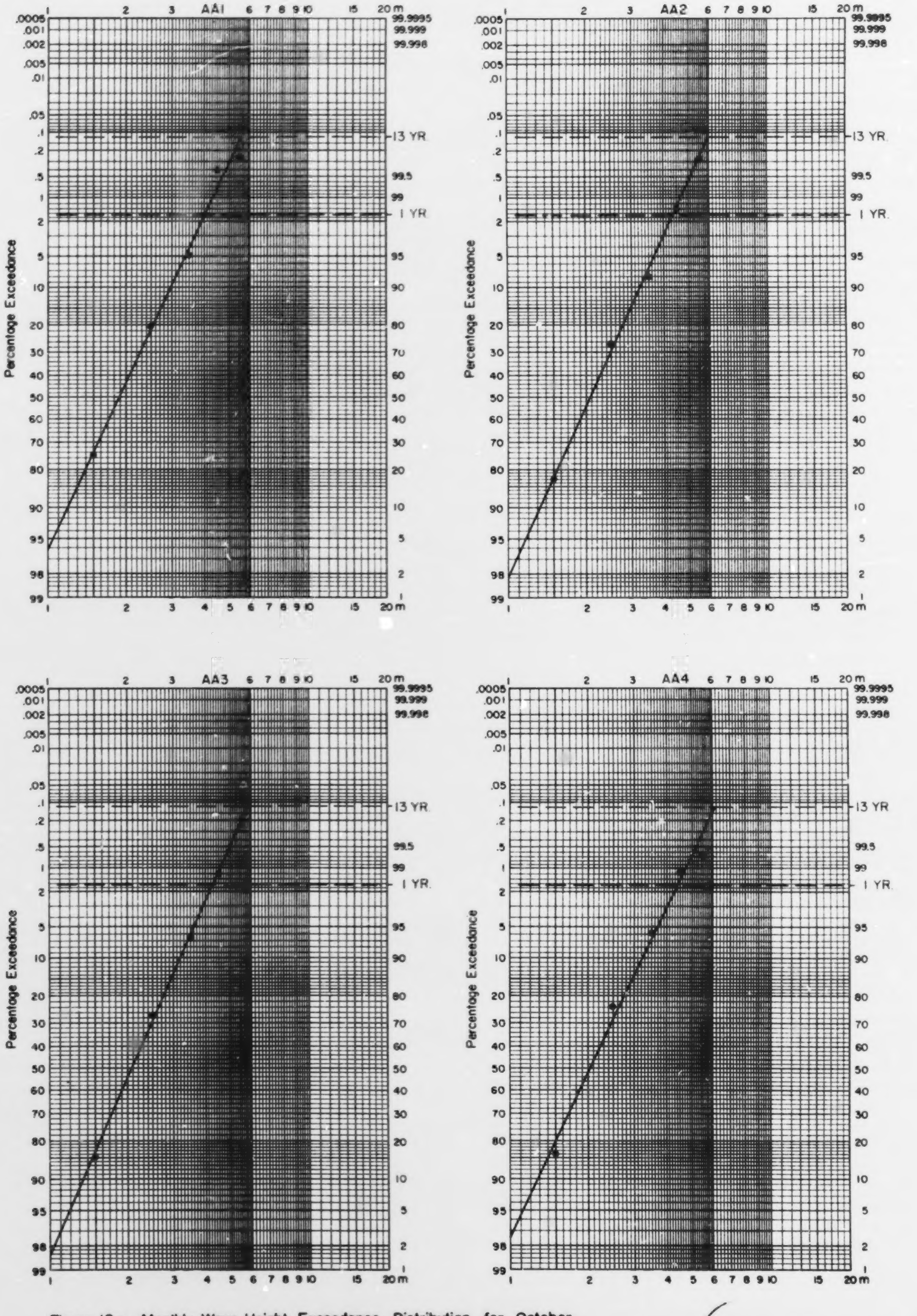
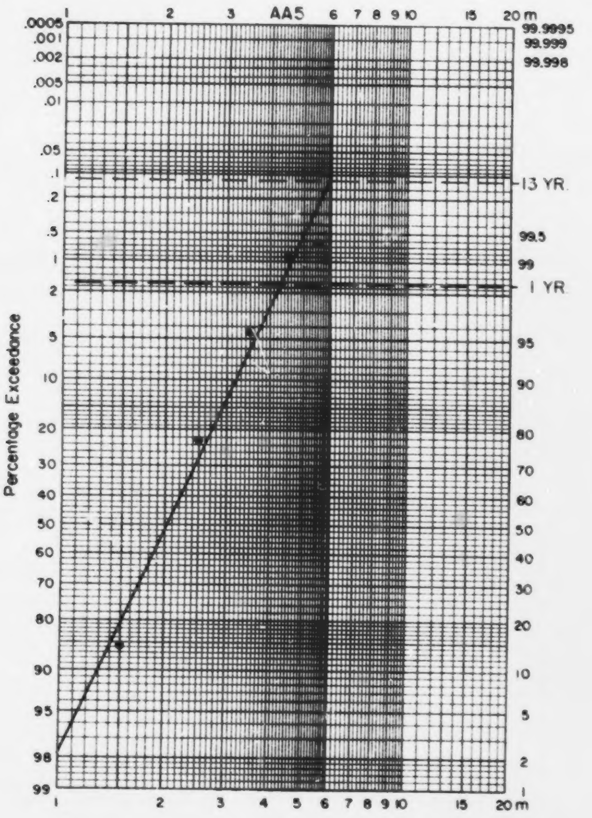
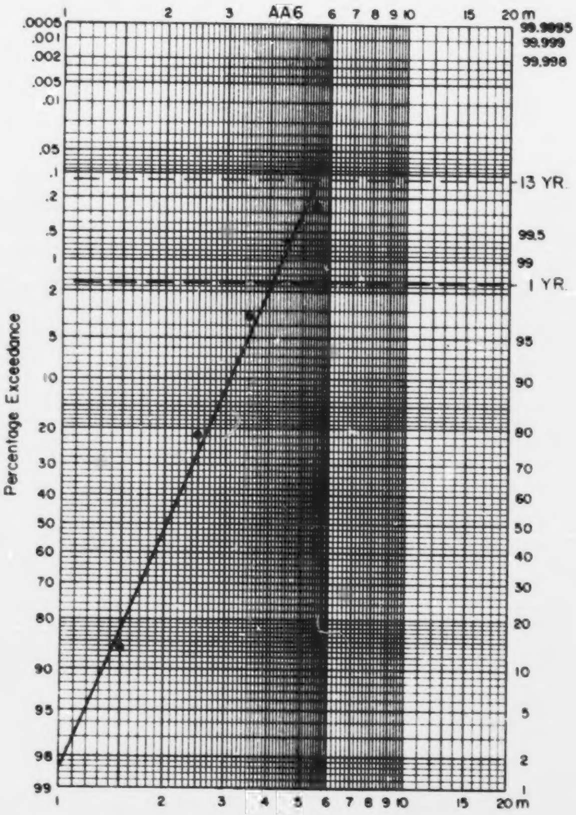
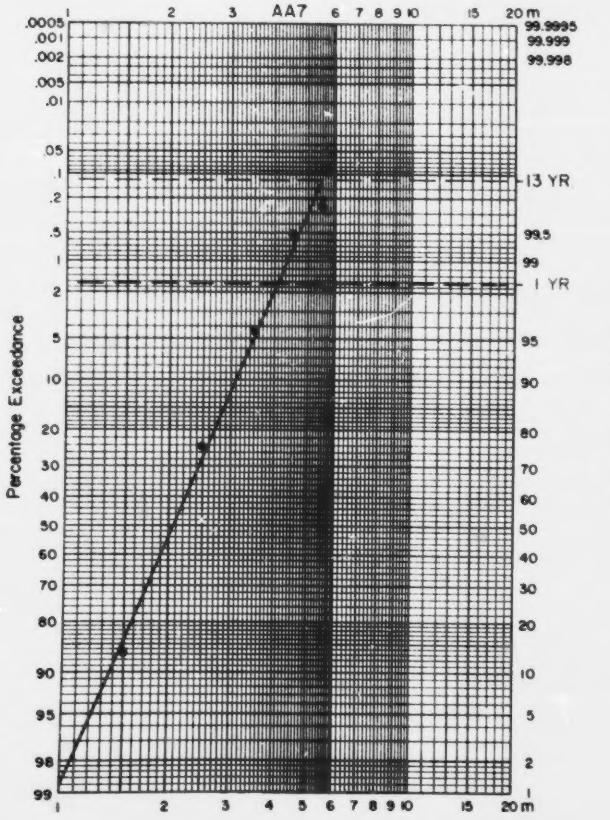


Figure 10a. Monthly Wave Height Exceedance Distribution for October







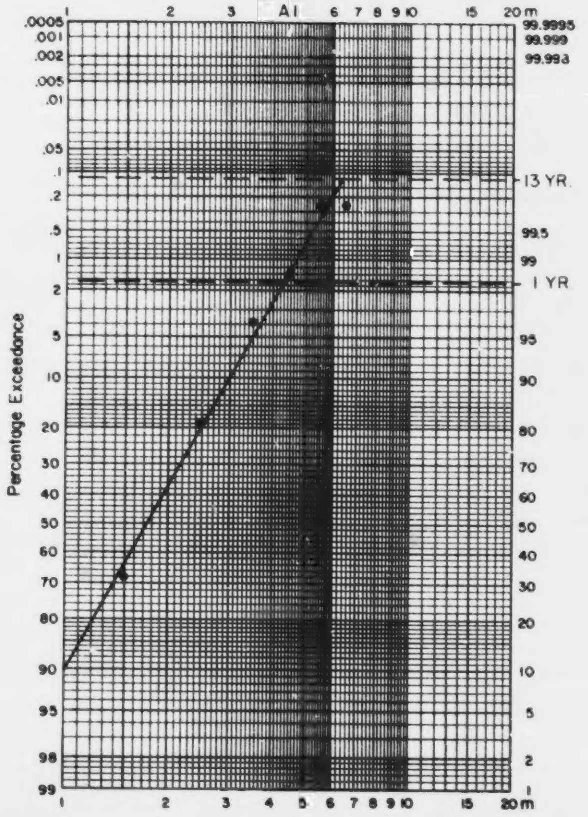


Figure 10b. Monthly Wave Height Exceedance Distribution for October

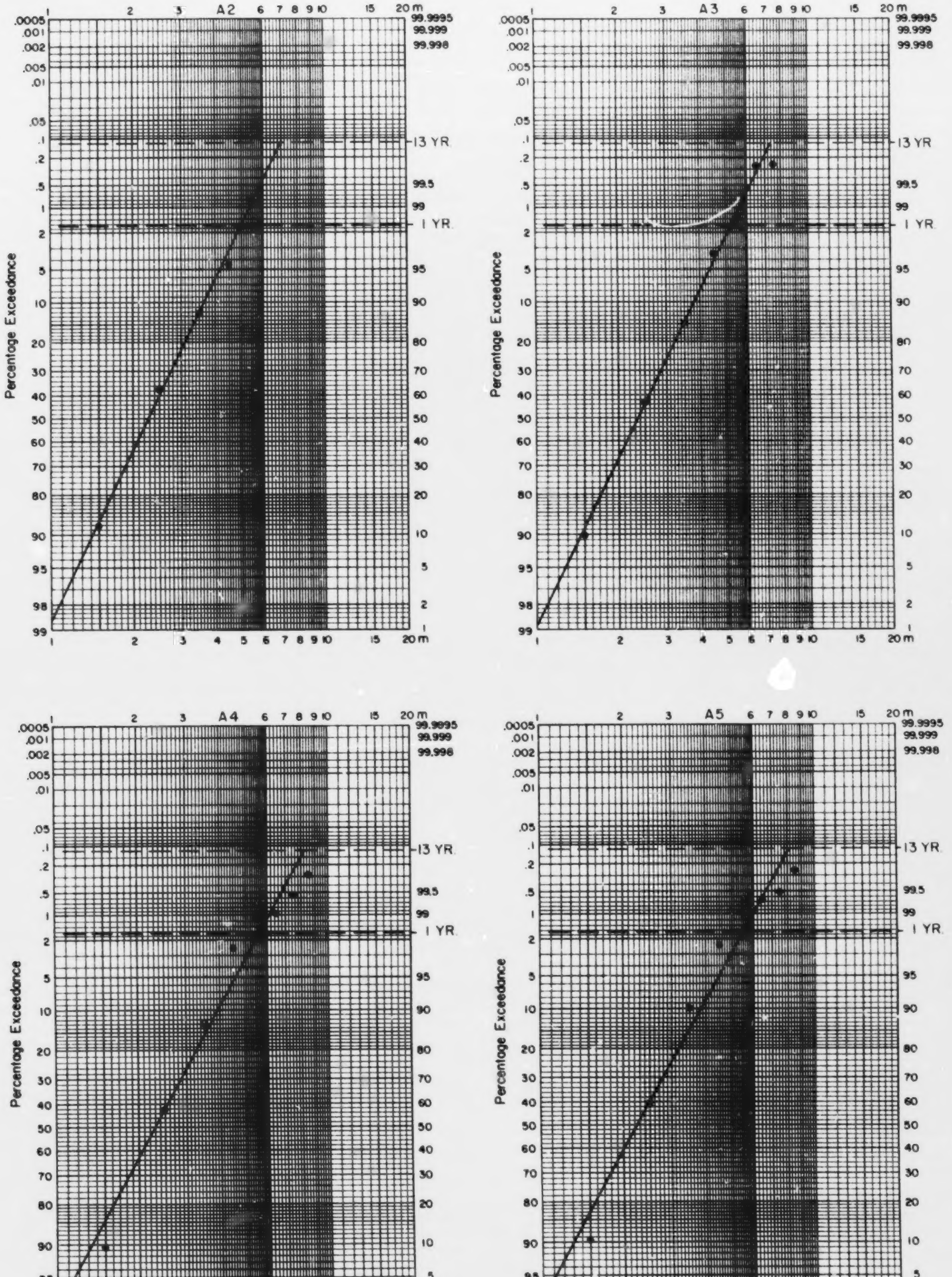


Figure 10c. Monthly Wave Height Exceedance Distribution for October

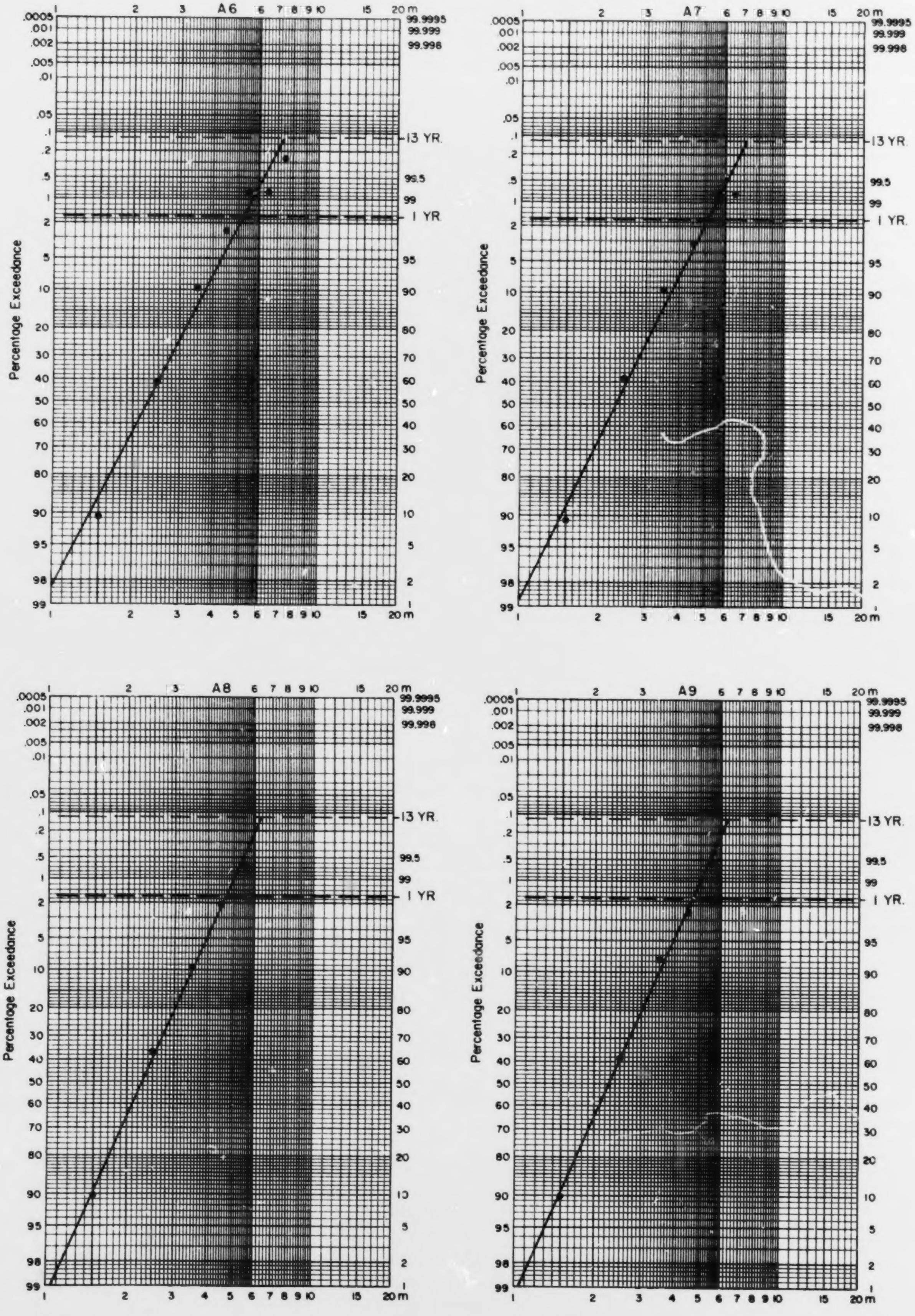


Figure 10d. Monthly Wave Height Exceedance Distribution for October

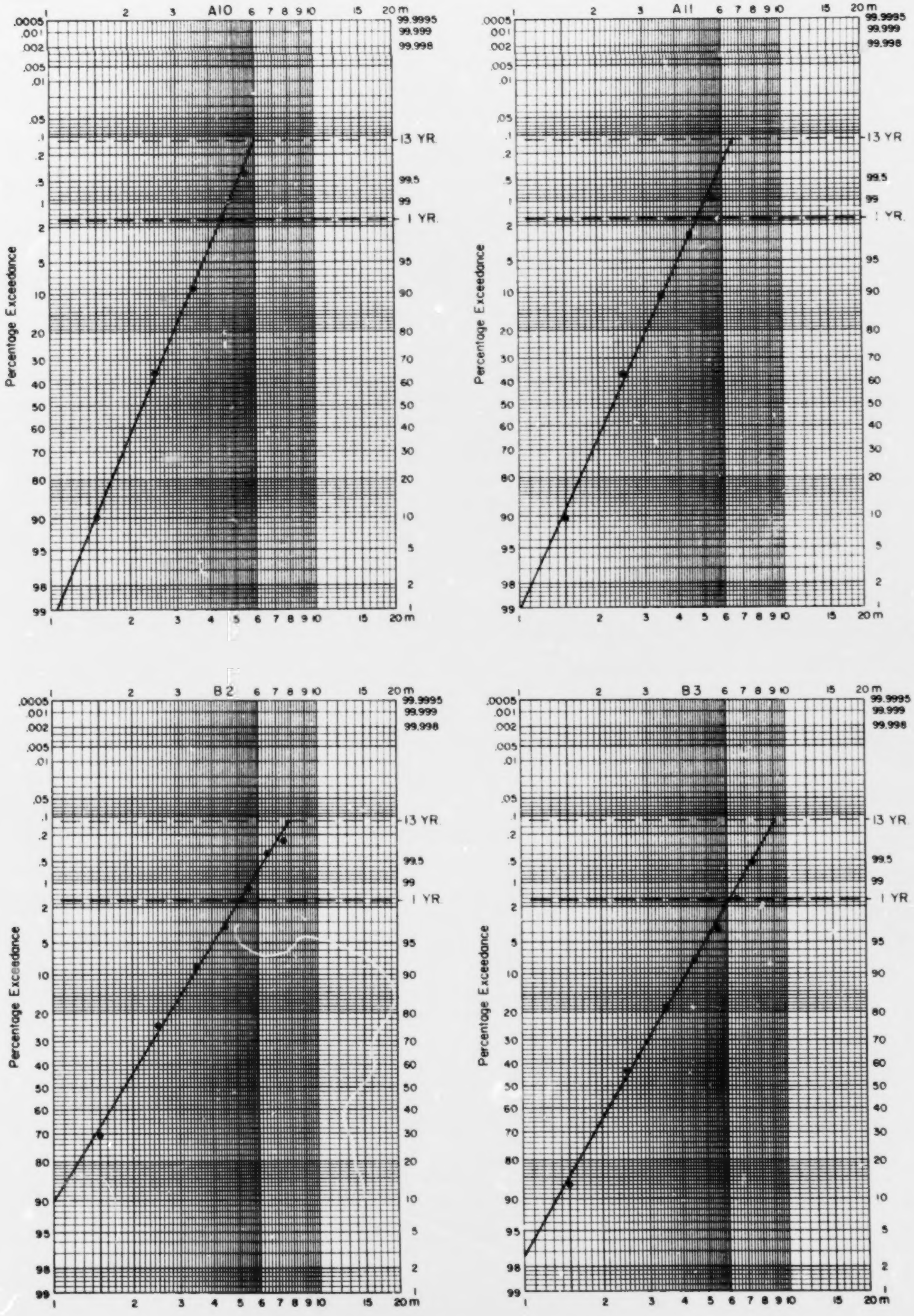


Figure 10e. Monthly Wave Height Exceedance Distribution for October

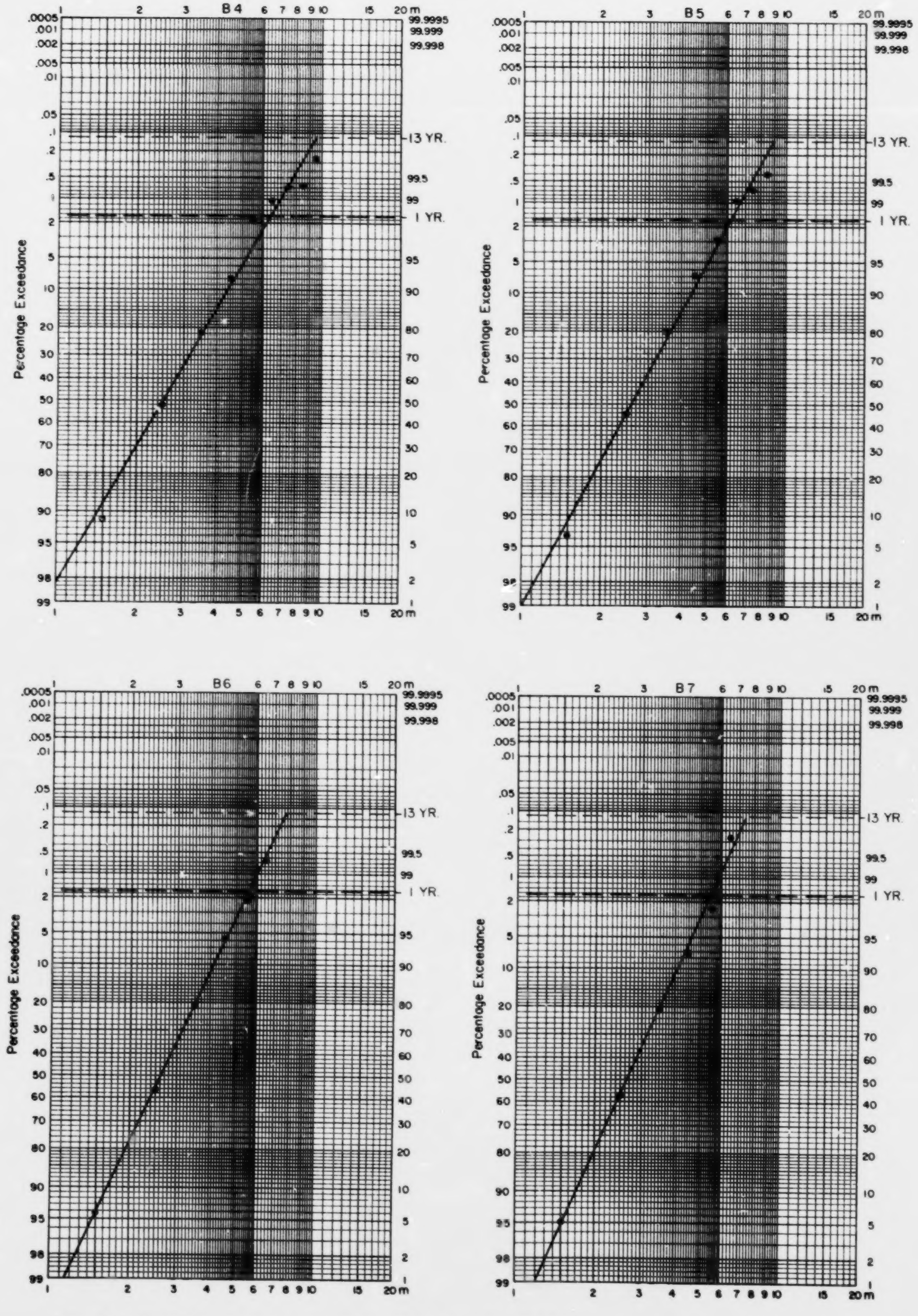


Figure 10f. Monthly Wave Height Exceedance Distribution for October

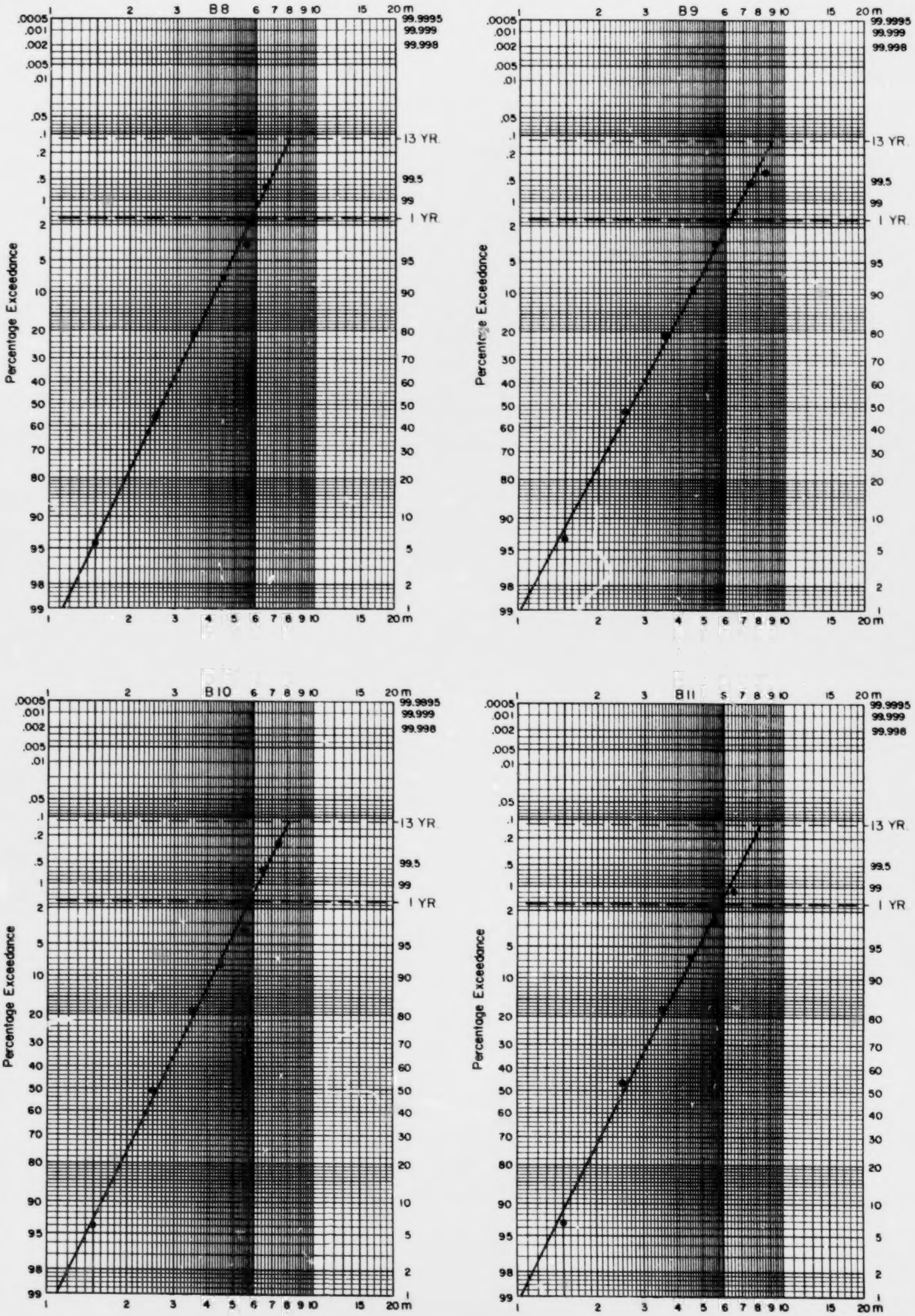


Figure 10g. Monthly Wave Height Exceedance Distribution for October

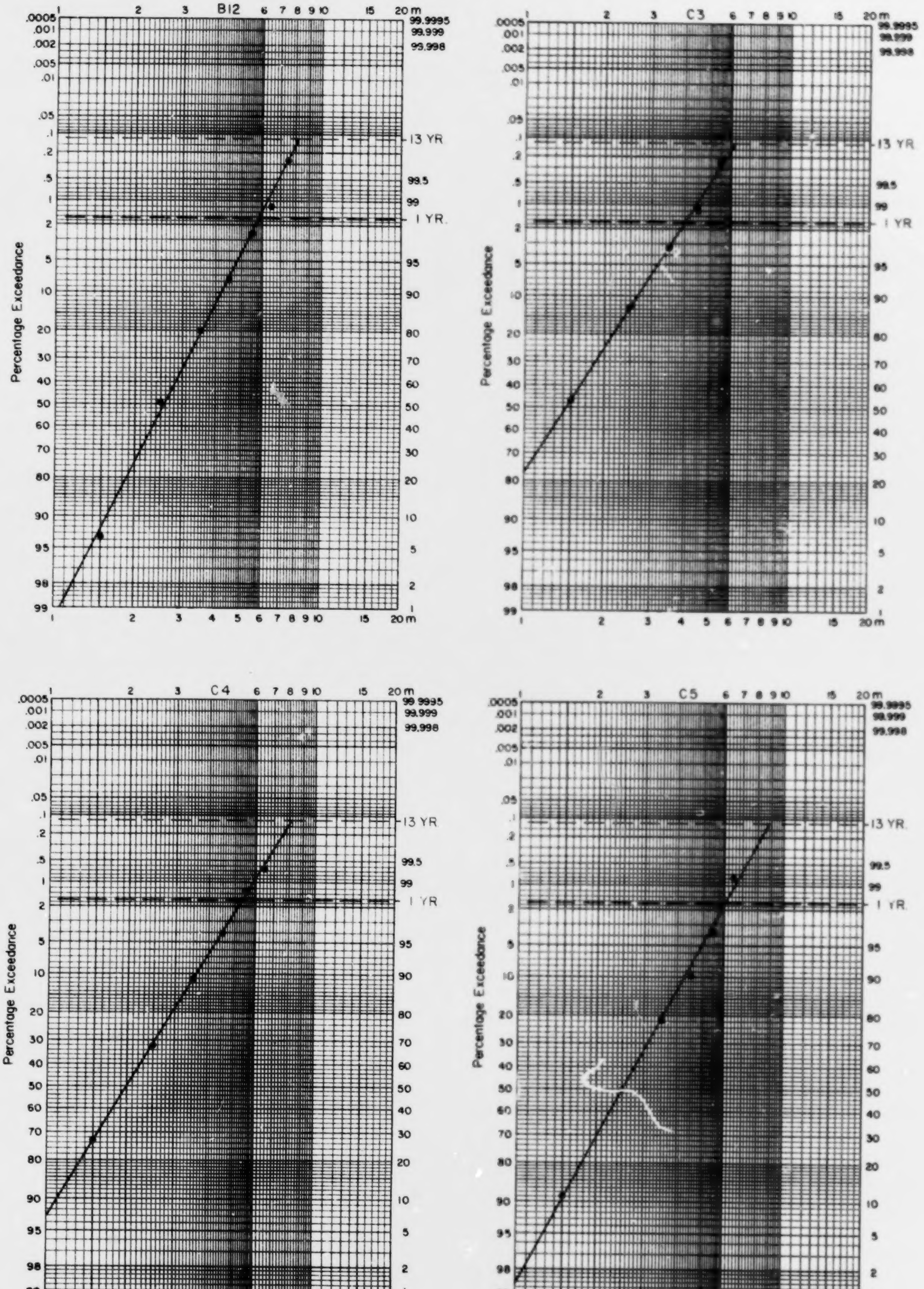


Figure 10h. Monthly Wave Height Exceedance Distribution for October

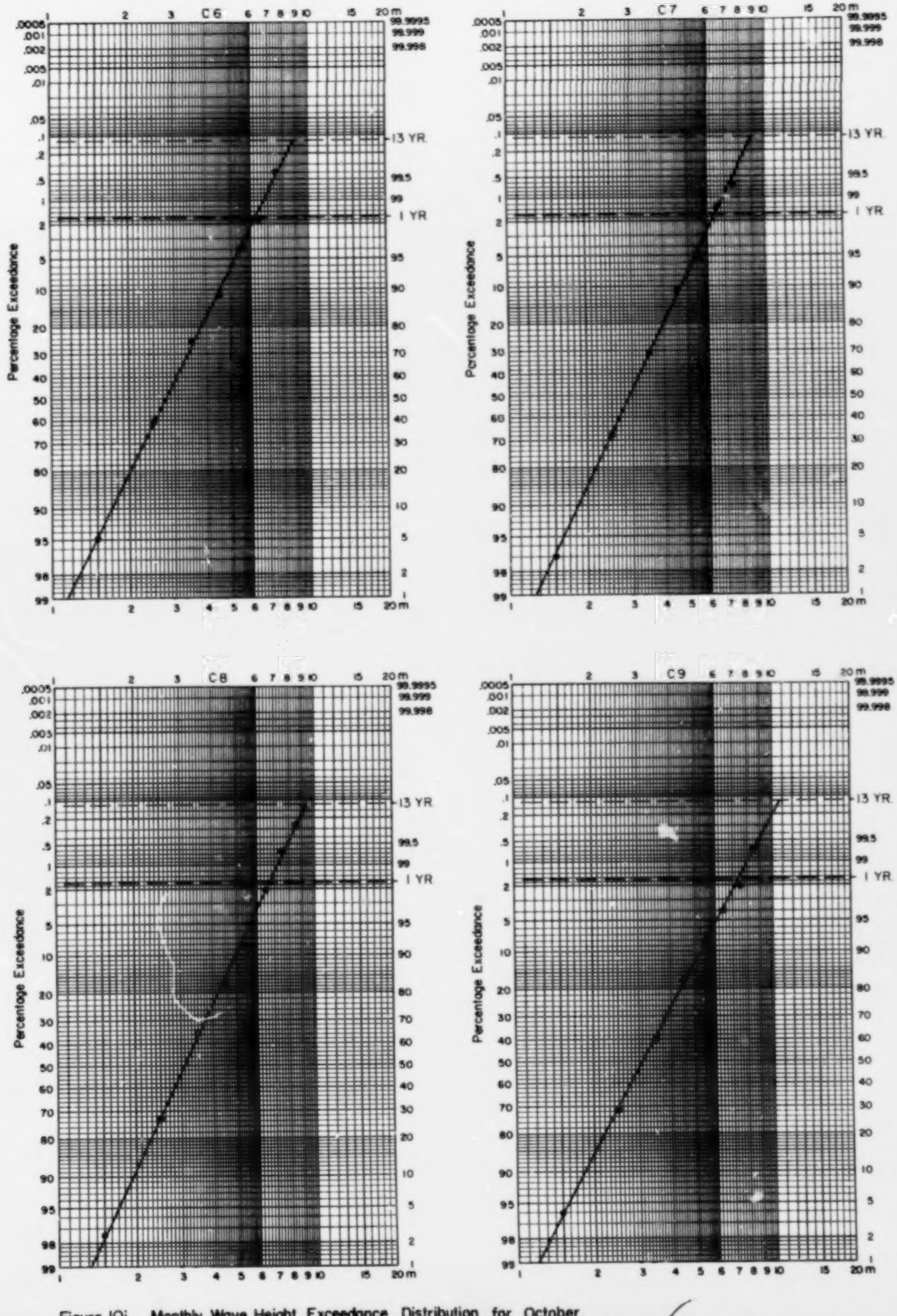


Figure 10i. Monthly Wave Height Exceedance Distribution for October

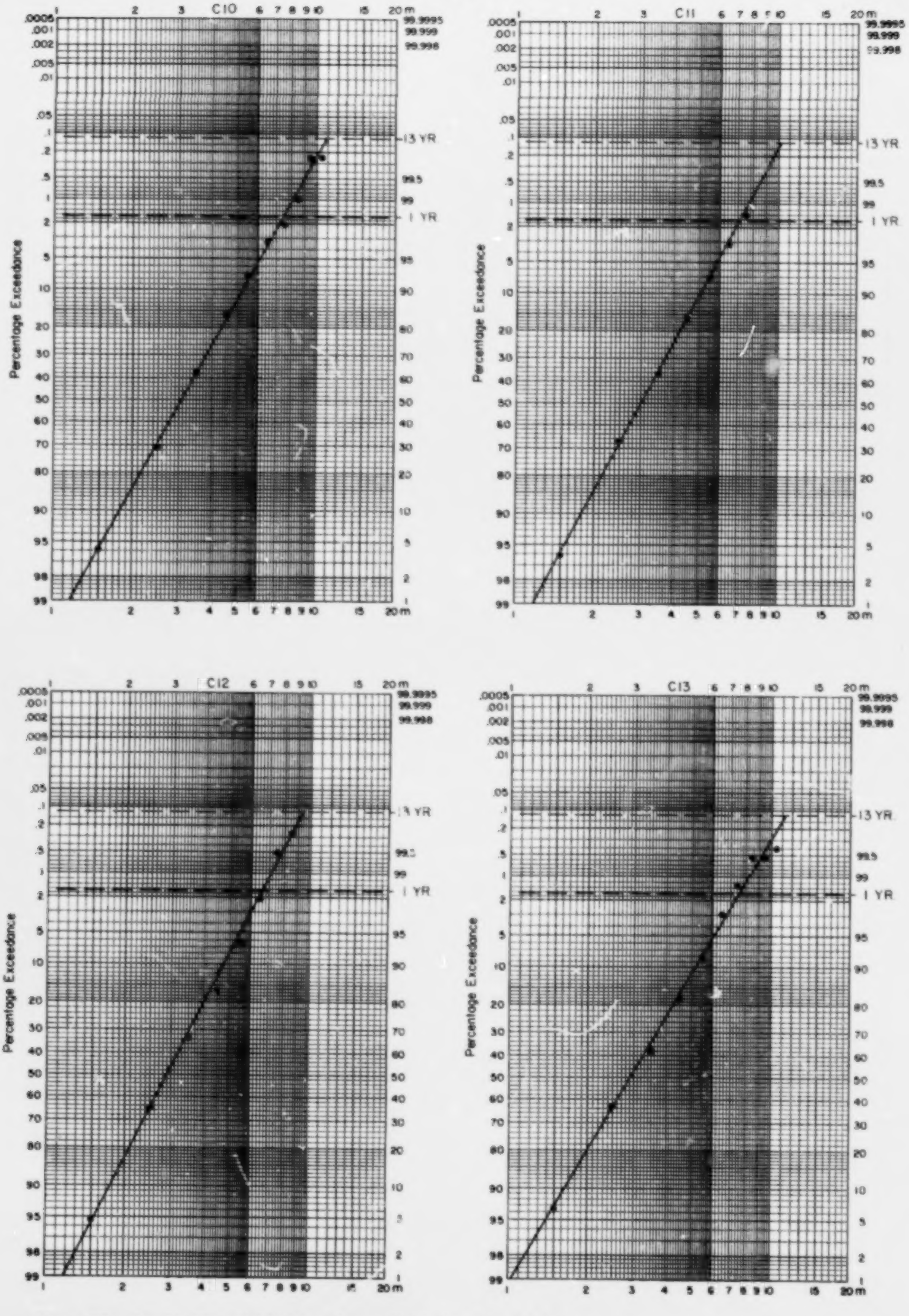


Figure 10j. Monthly Wave Height Exceedance Distribution for October

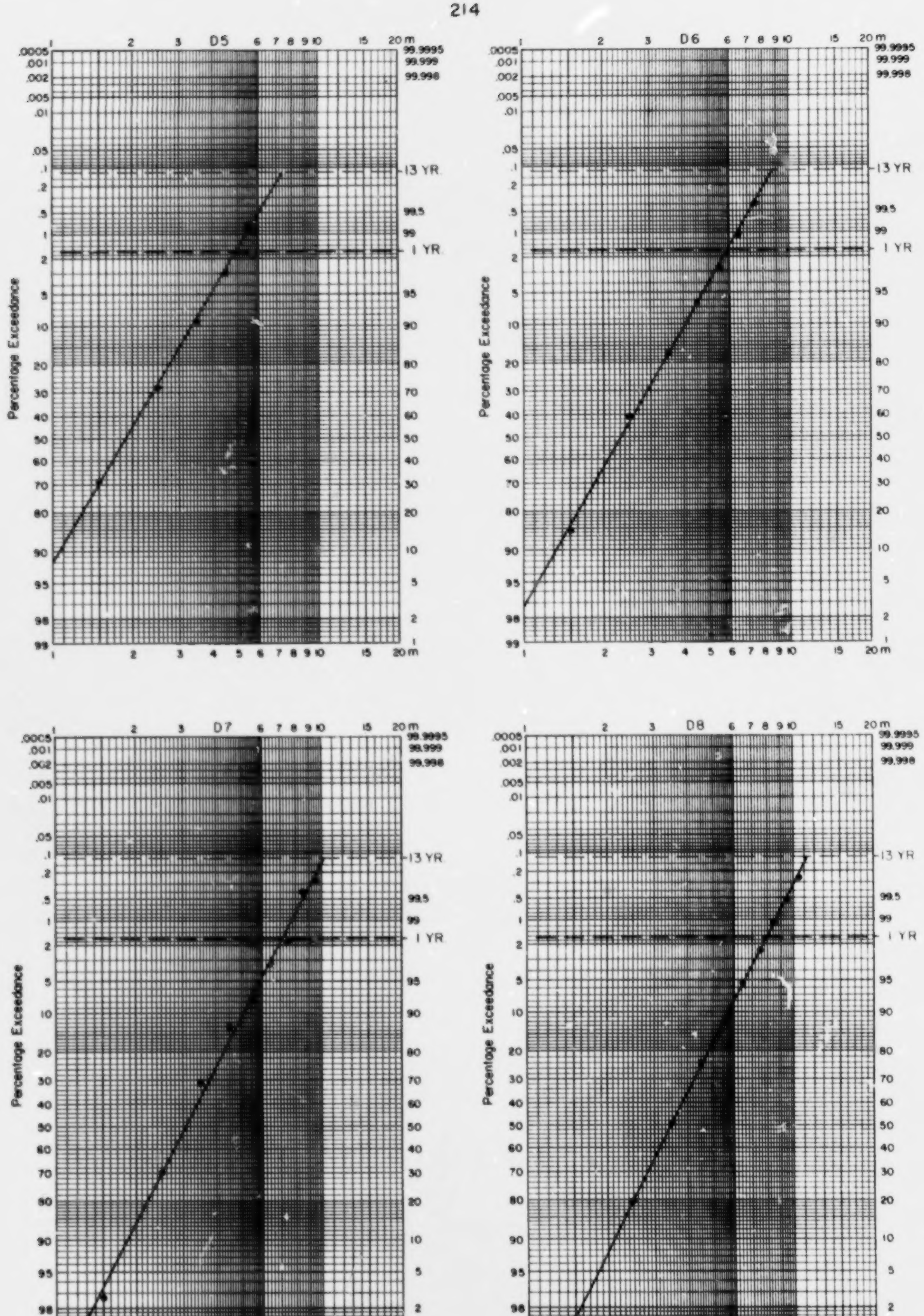


Figure 10k. Monthly Wave Height Exceedance Distribution for October

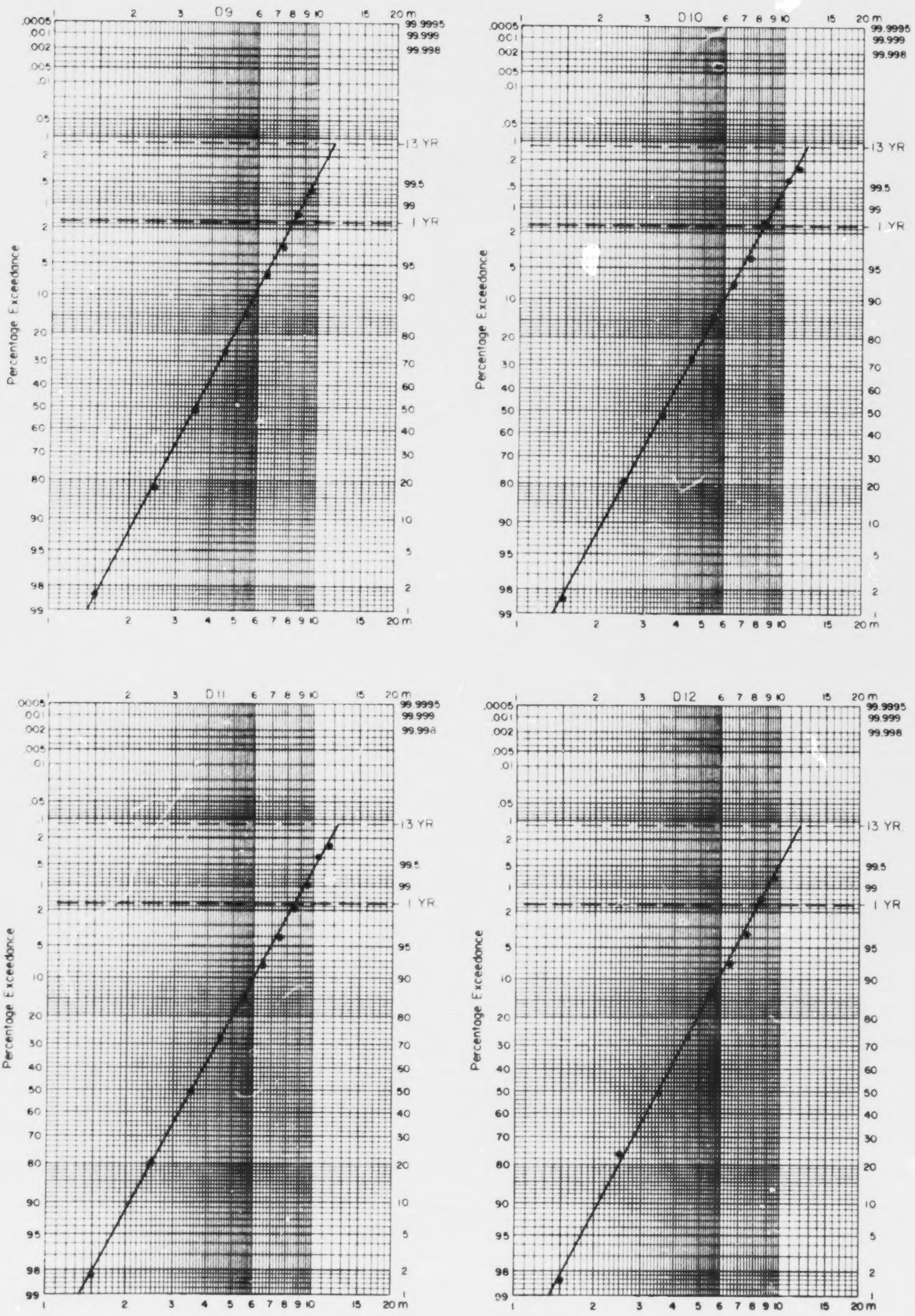


Figure 101. Monthly Wave Height Exceedance Distribution for October

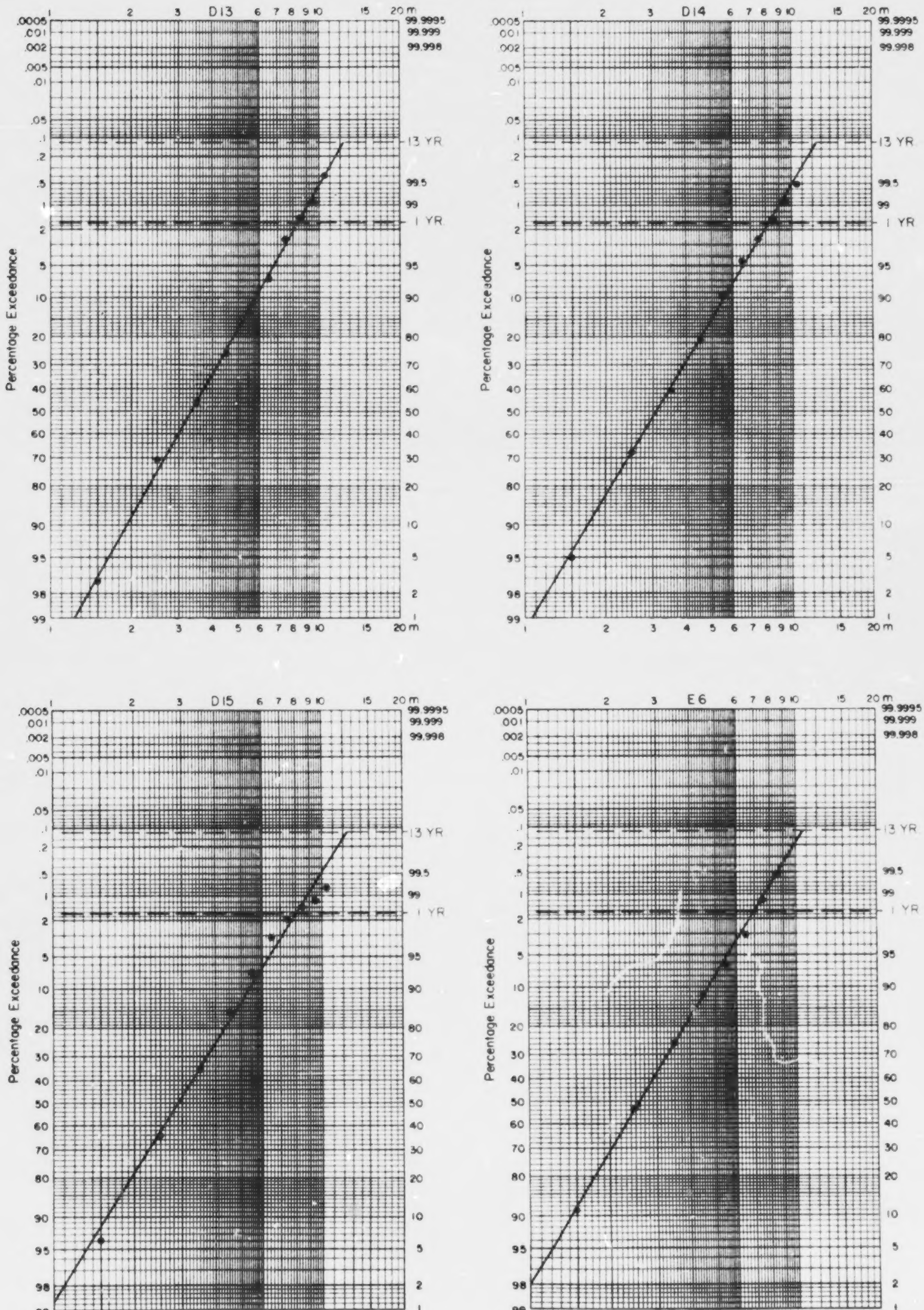


Figure 10m. Monthly Wave Height Exceedance Distribution for October

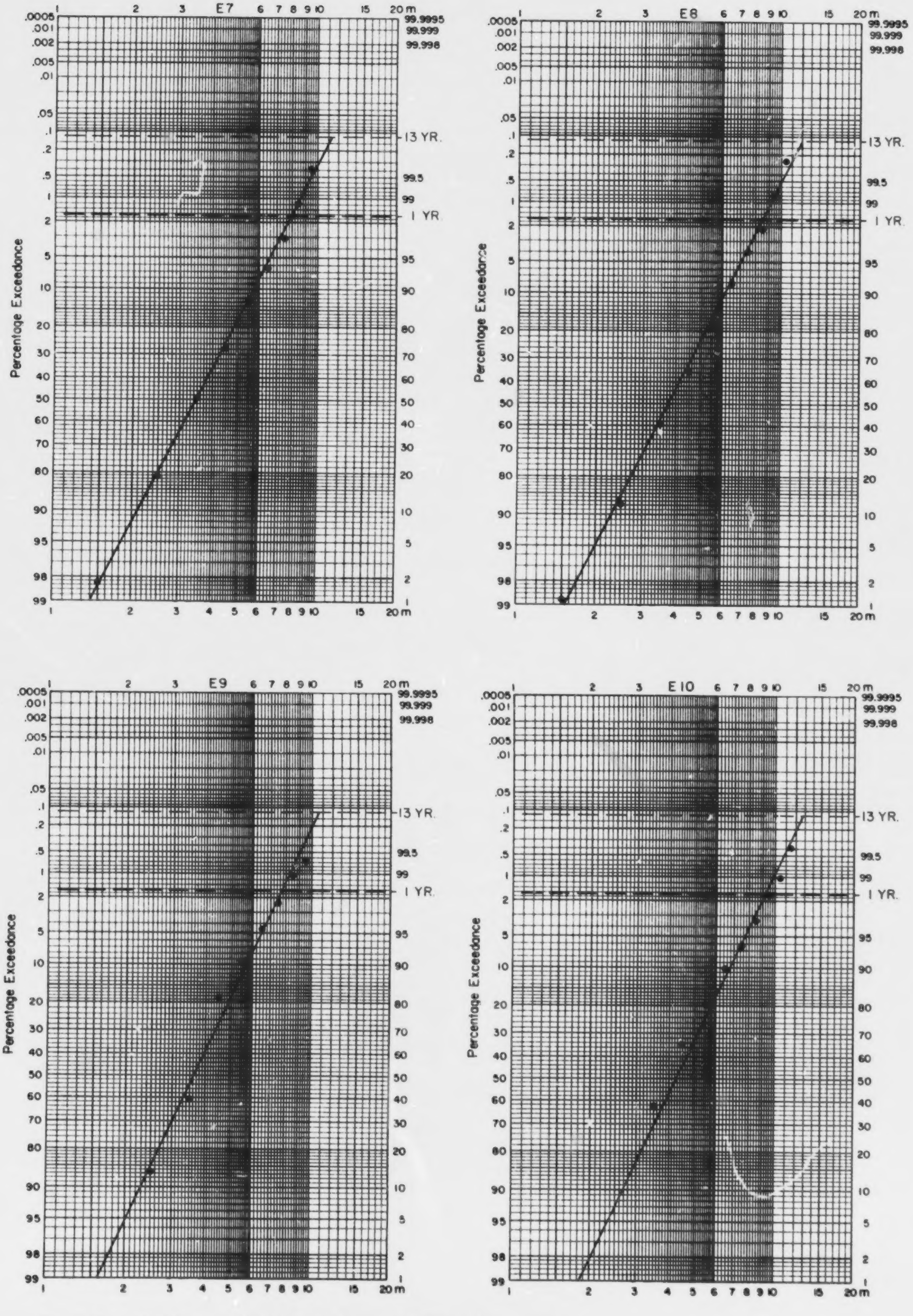


Figure 10n. Monthly Wave Height Exceedance Distribution for October

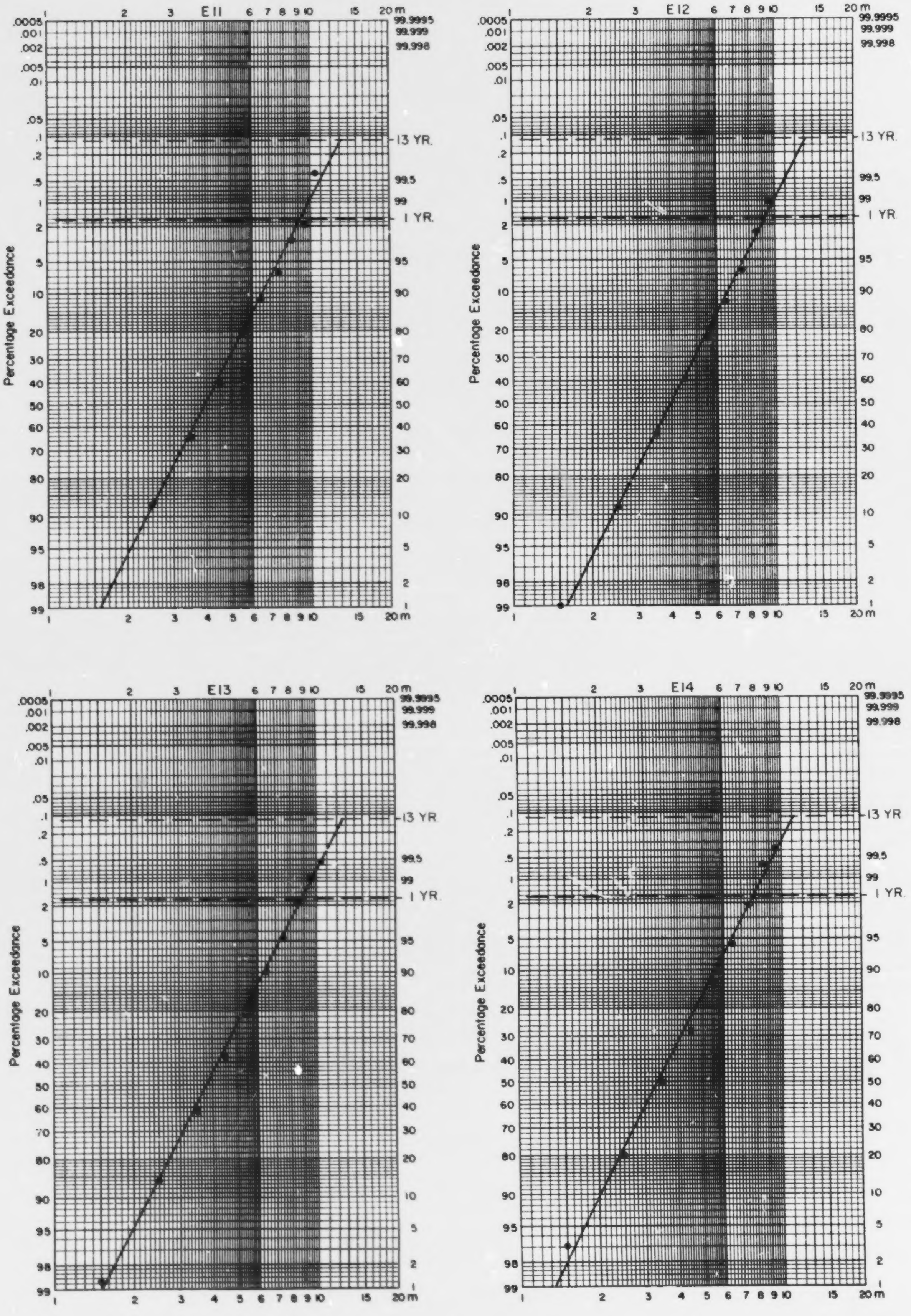


Figure 10o. Monthly Wave Height Exceedance Distribution for October

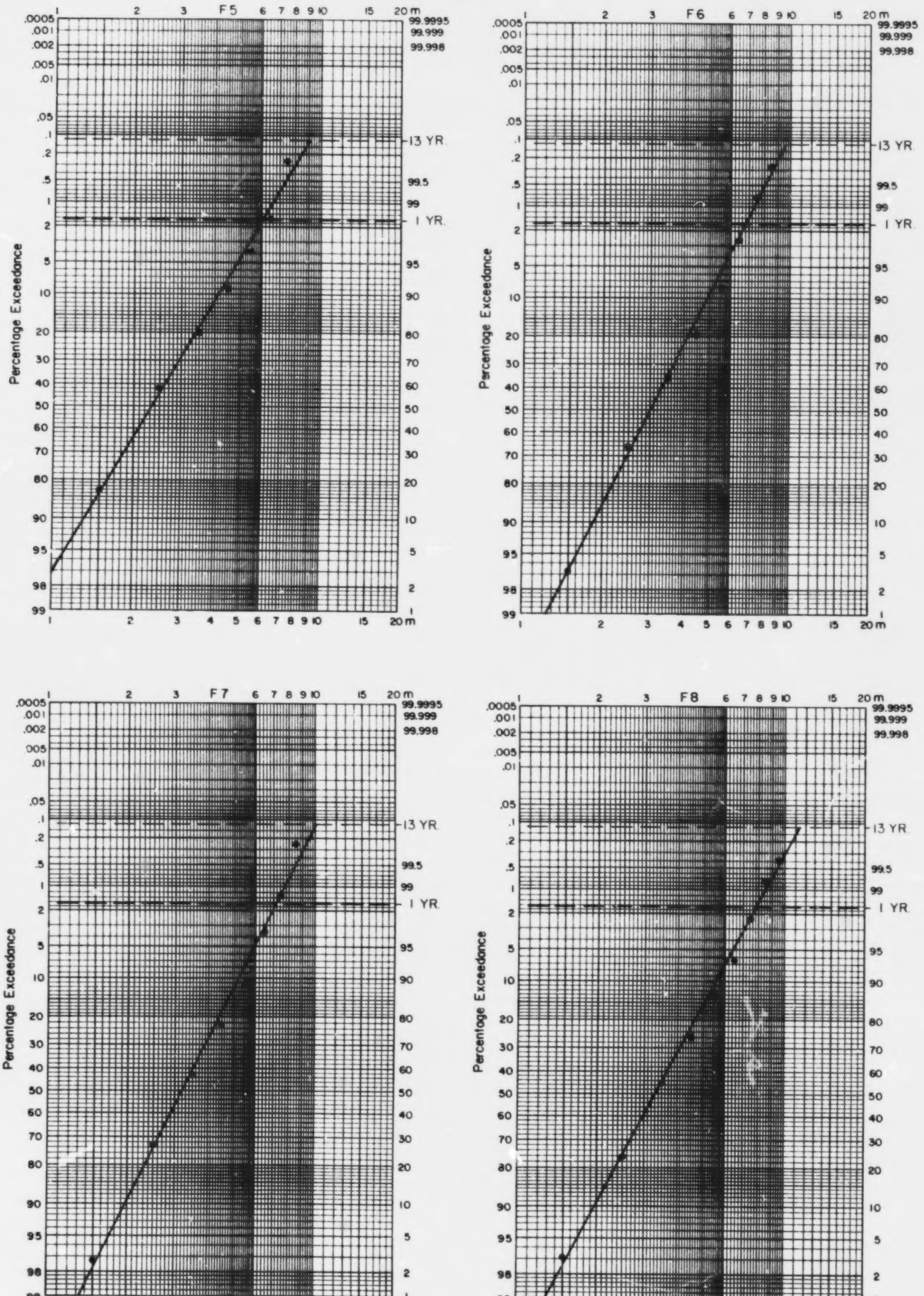


Figure 10p. Monthly Wave Height Exceedance Distribution for October

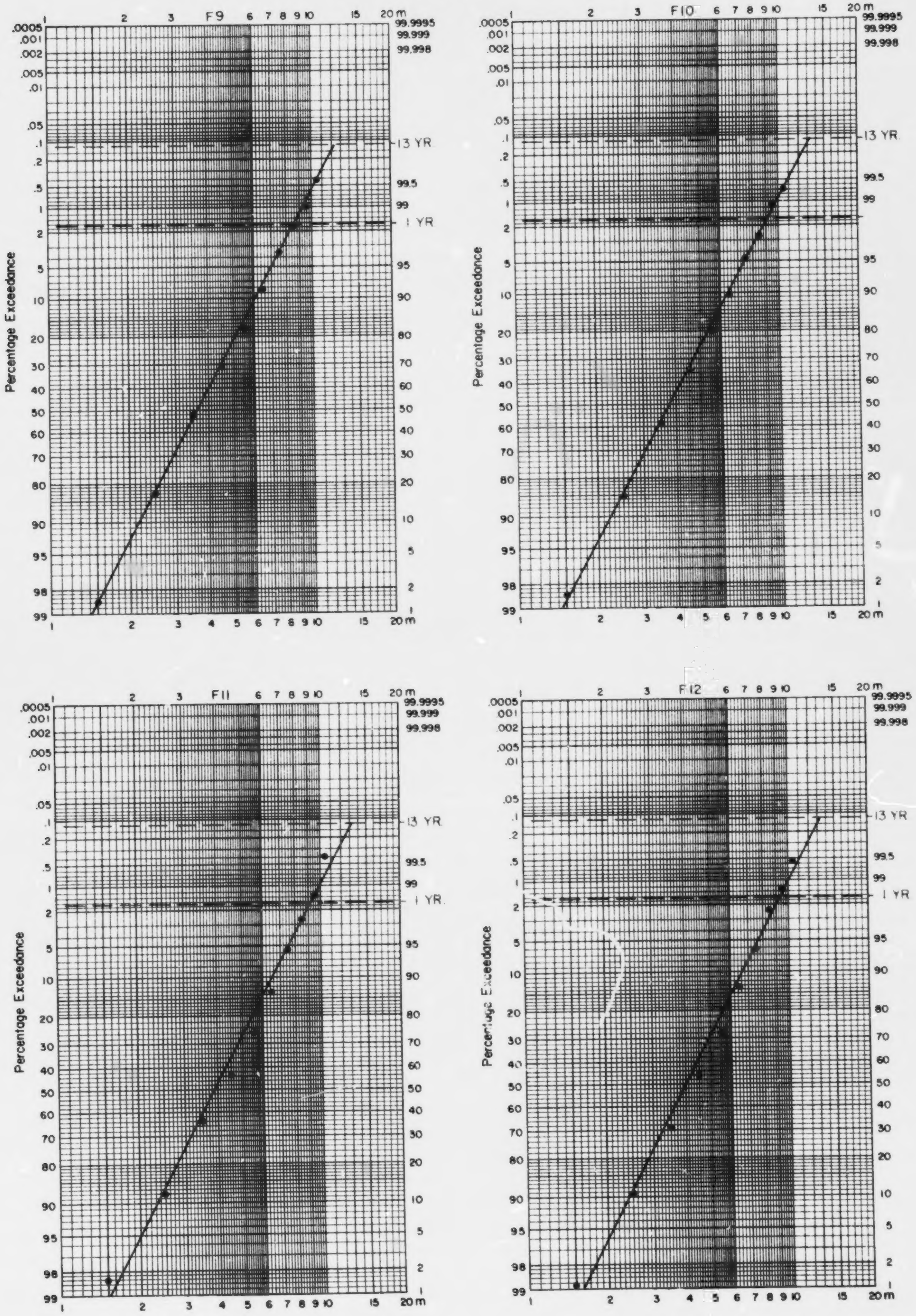


Figure 10q. Monthly Wave Height Exceedance Distribution for October

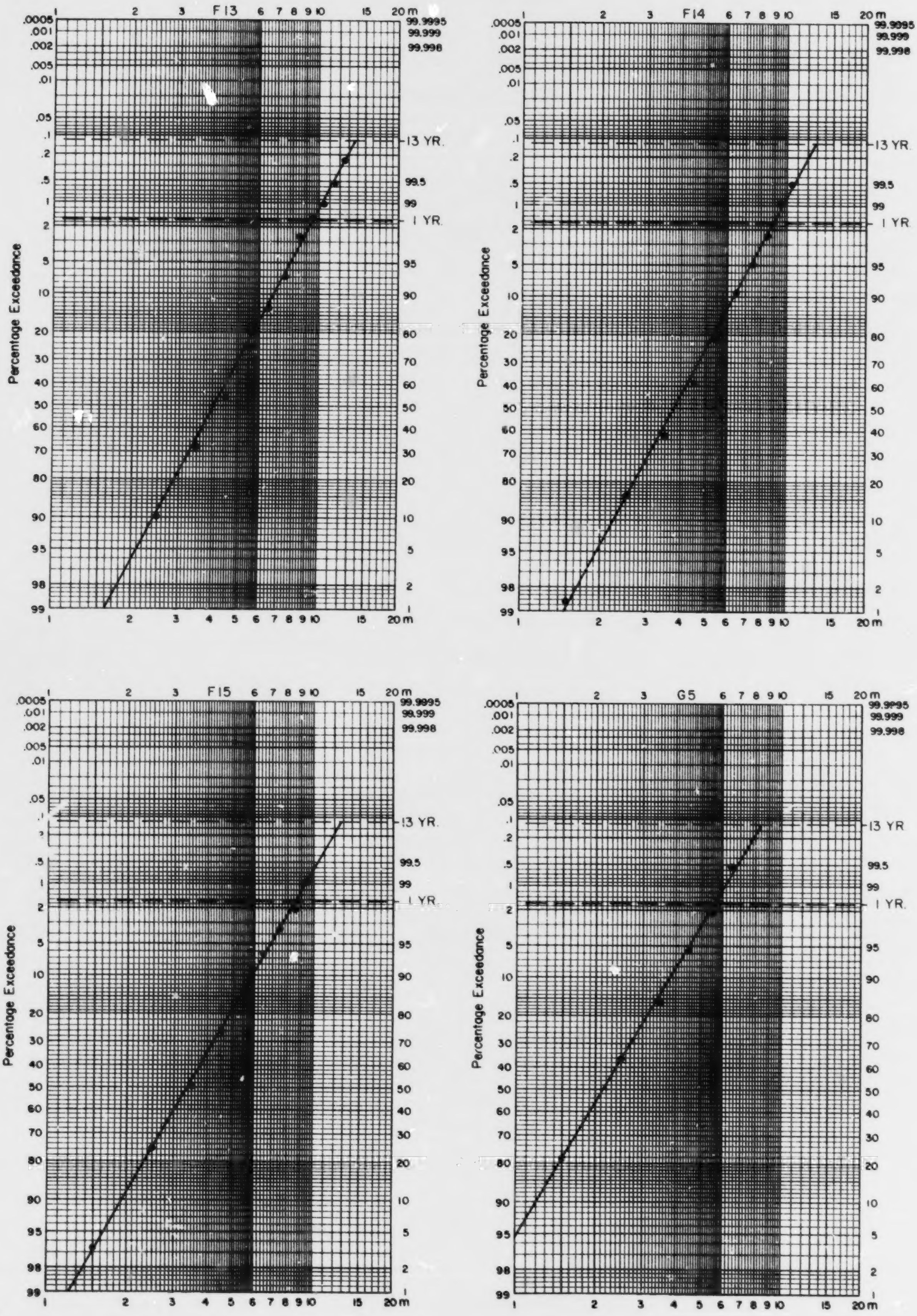


Figure 10r. Monthly Wave Height Exceedance Distribution for October

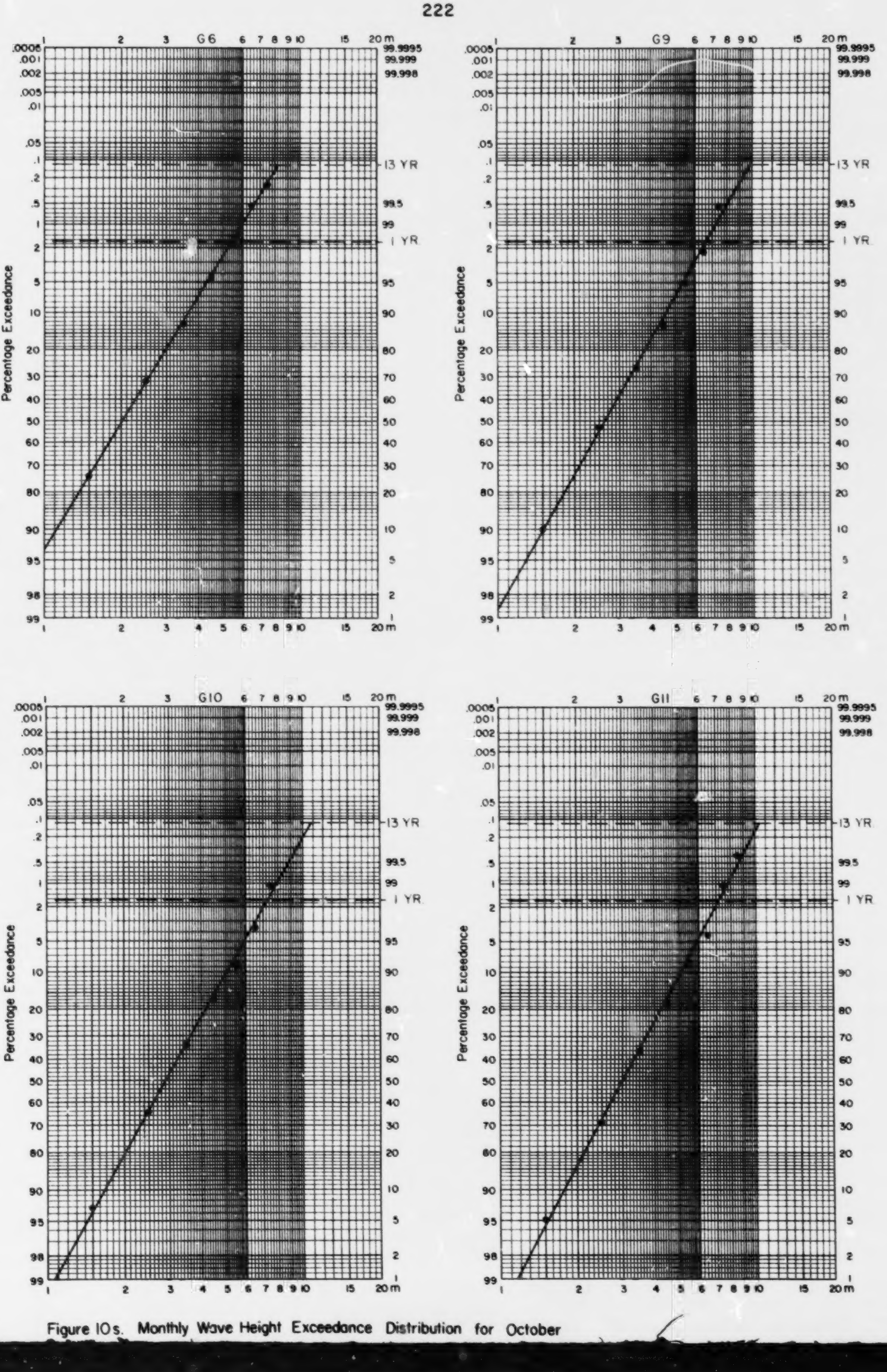


Figure 10s. Monthly Wave Height Exceedance Distribution for October

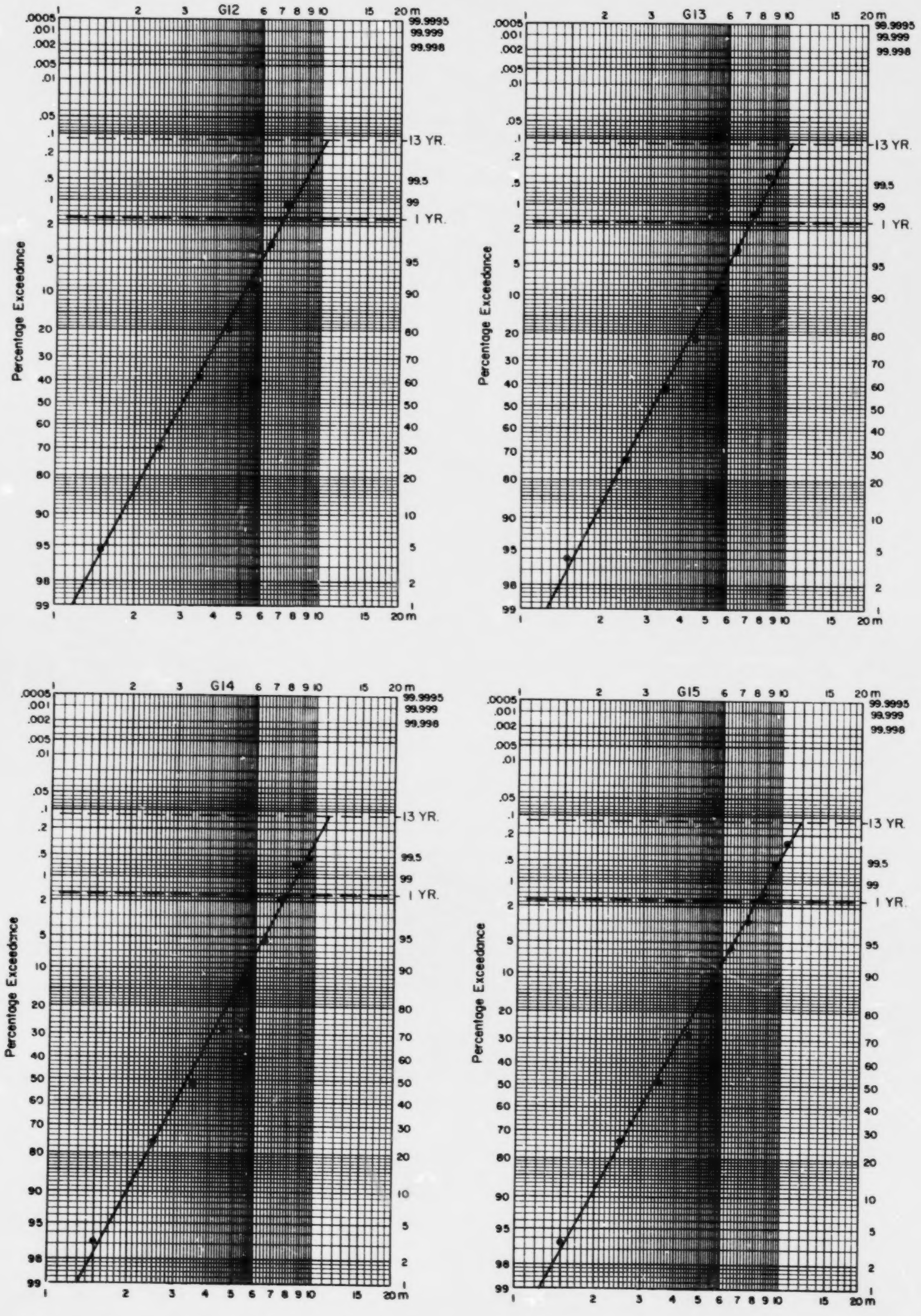
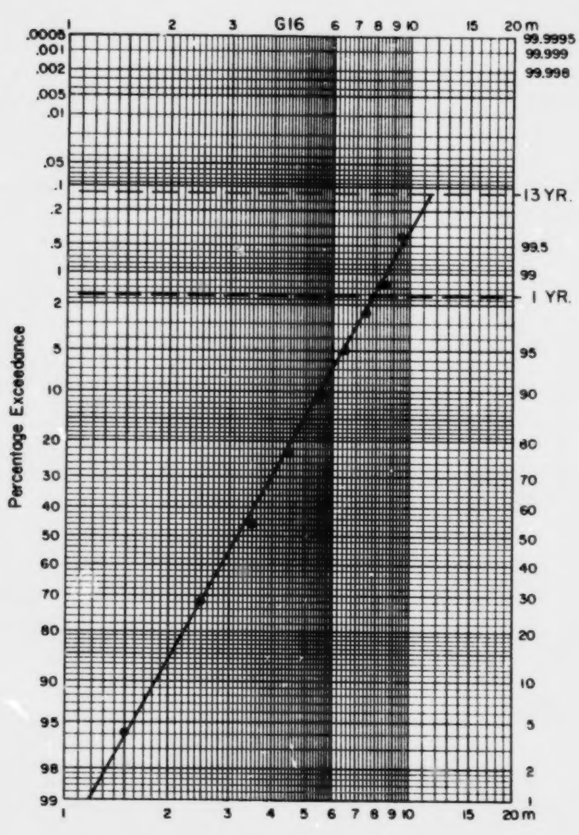
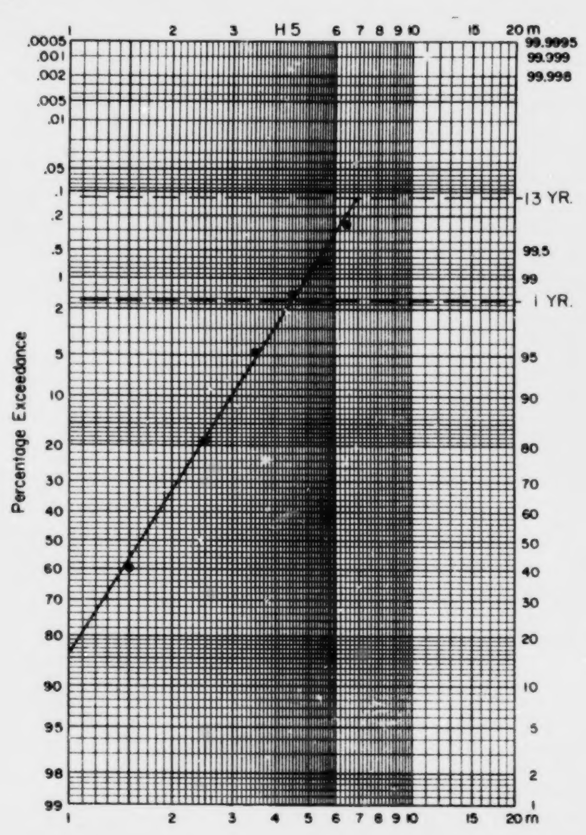
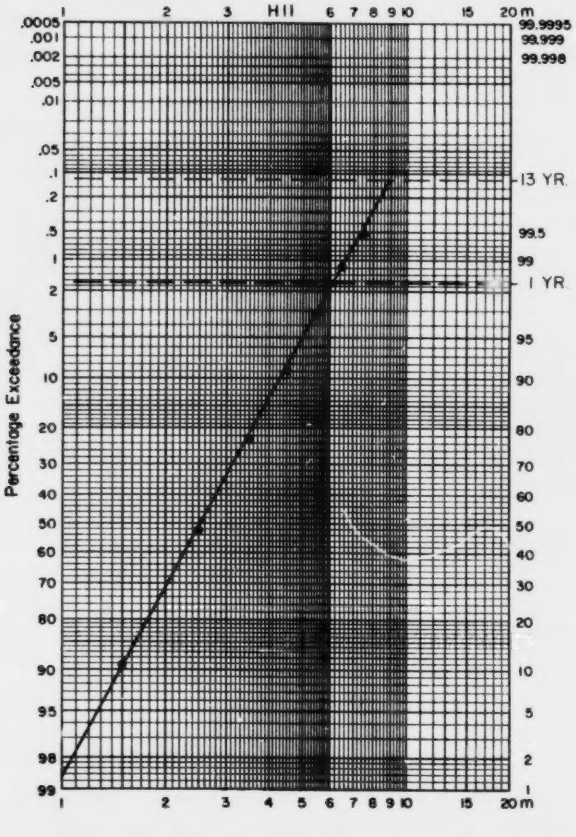


Figure 10t. Monthly Wave Height Exceedance Distribution for October







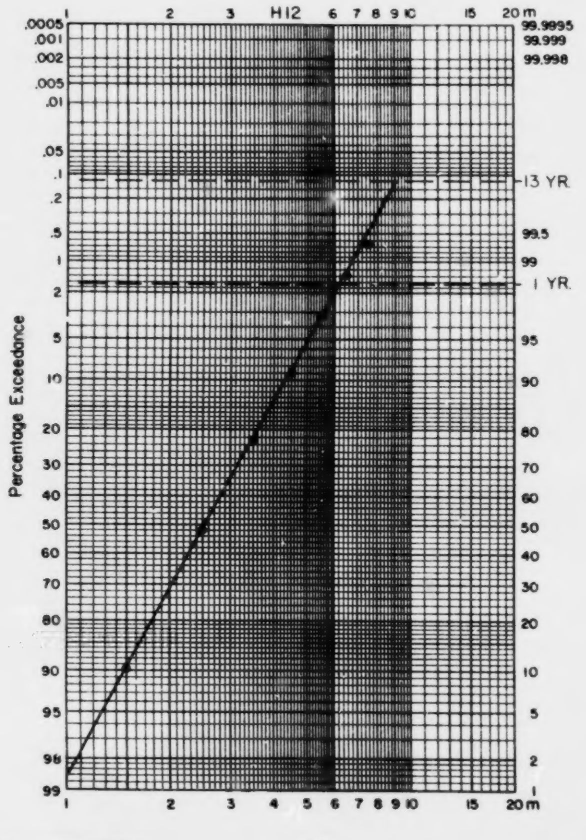


Figure 10u. Monthly Wave Height Exceedance Distribution for October

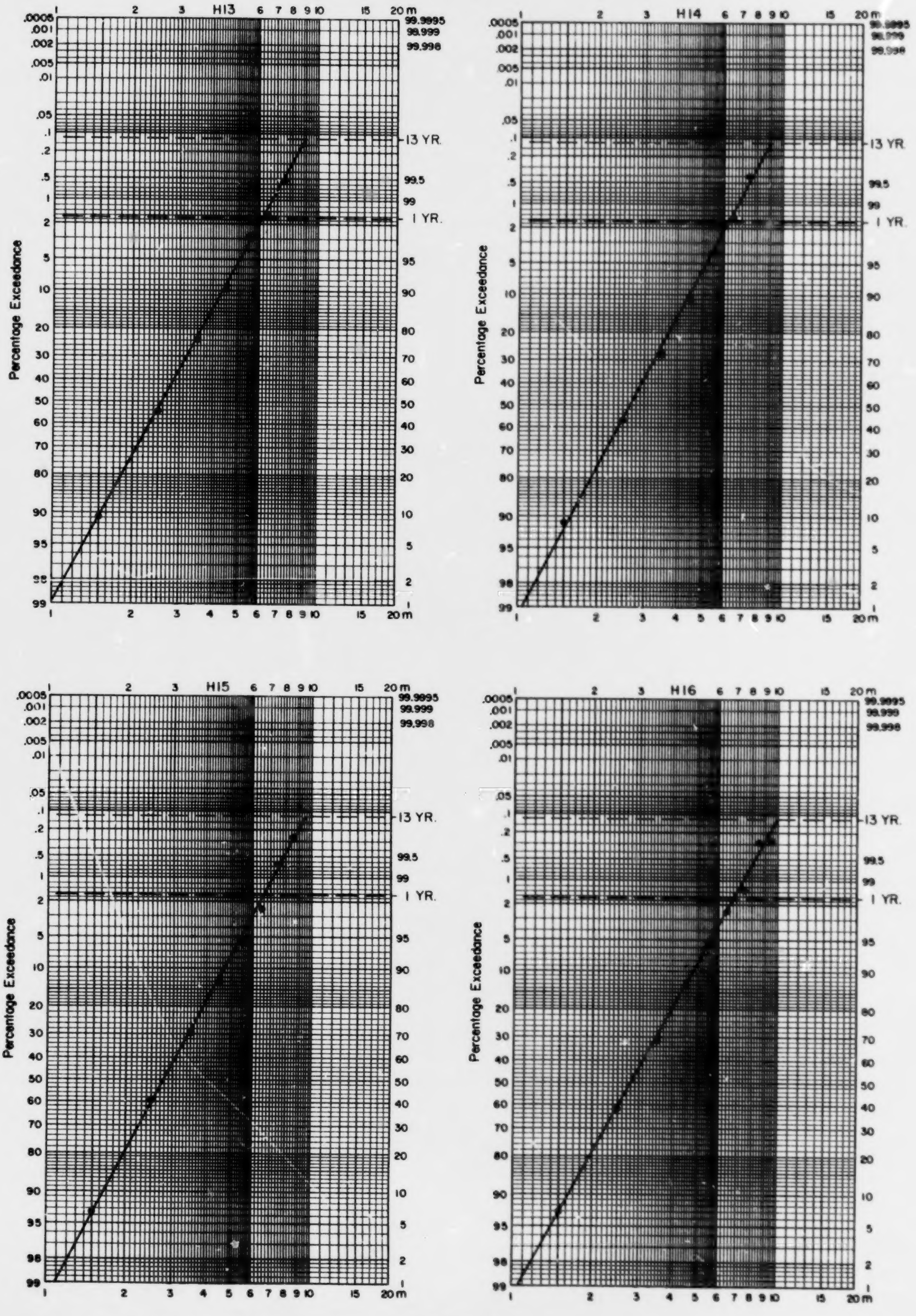


Figure 10v. Monthly Wave Height Exceedance Distribution for October

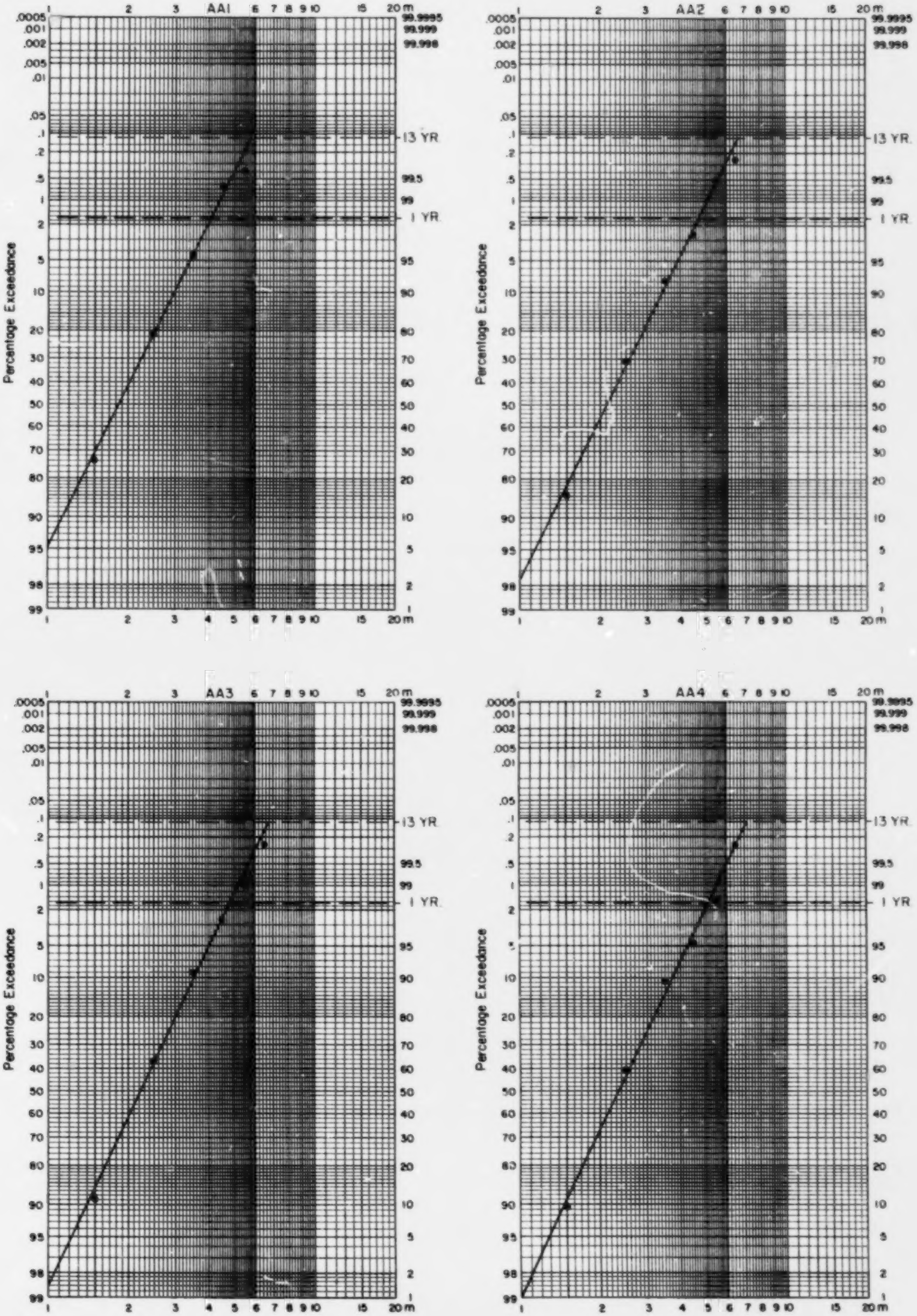


Figure 11a. Monthly Wave Height Exceedance Distribution for November

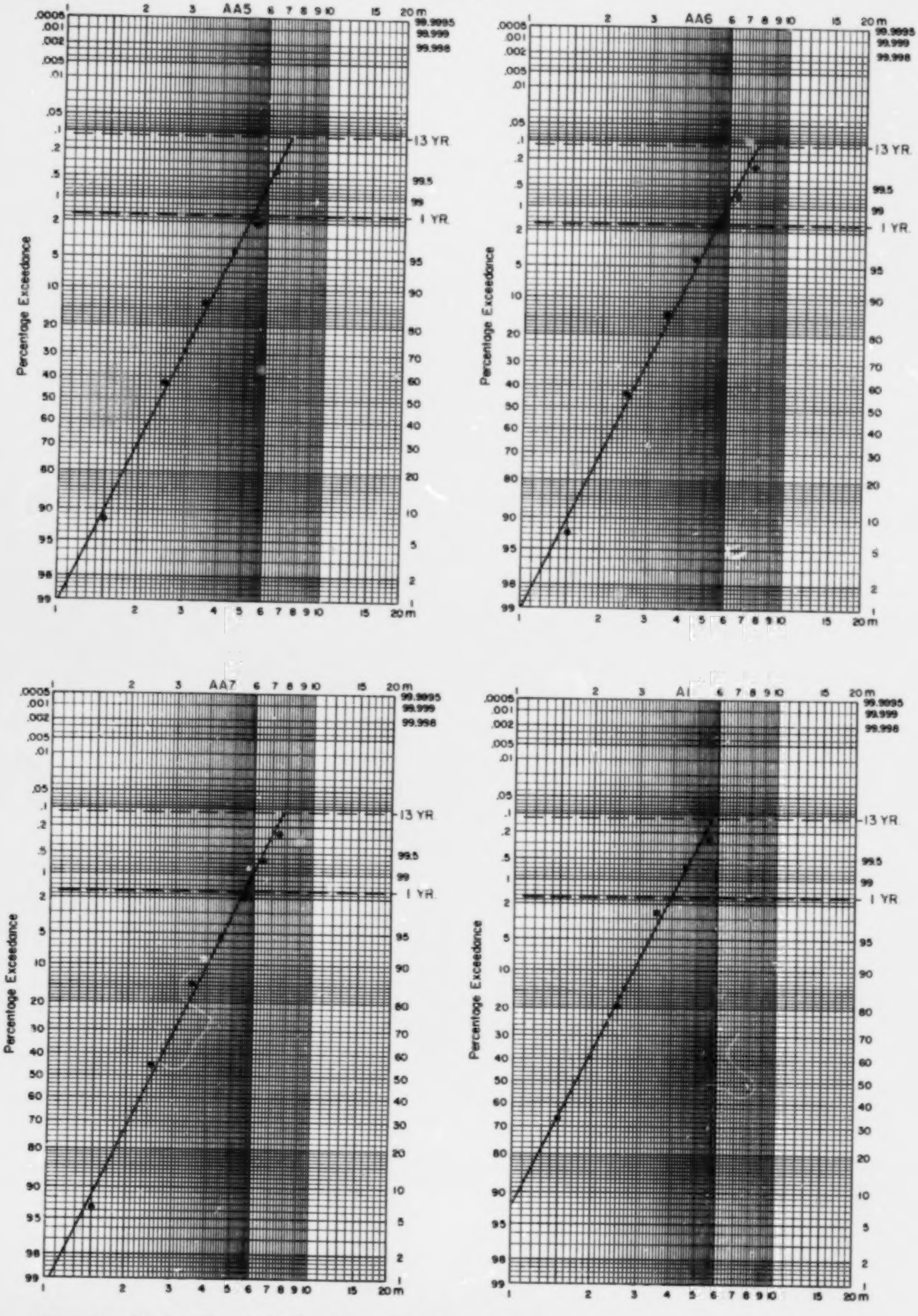


Figure 11b. Monthly Wave Height Exceedance Distribution for November

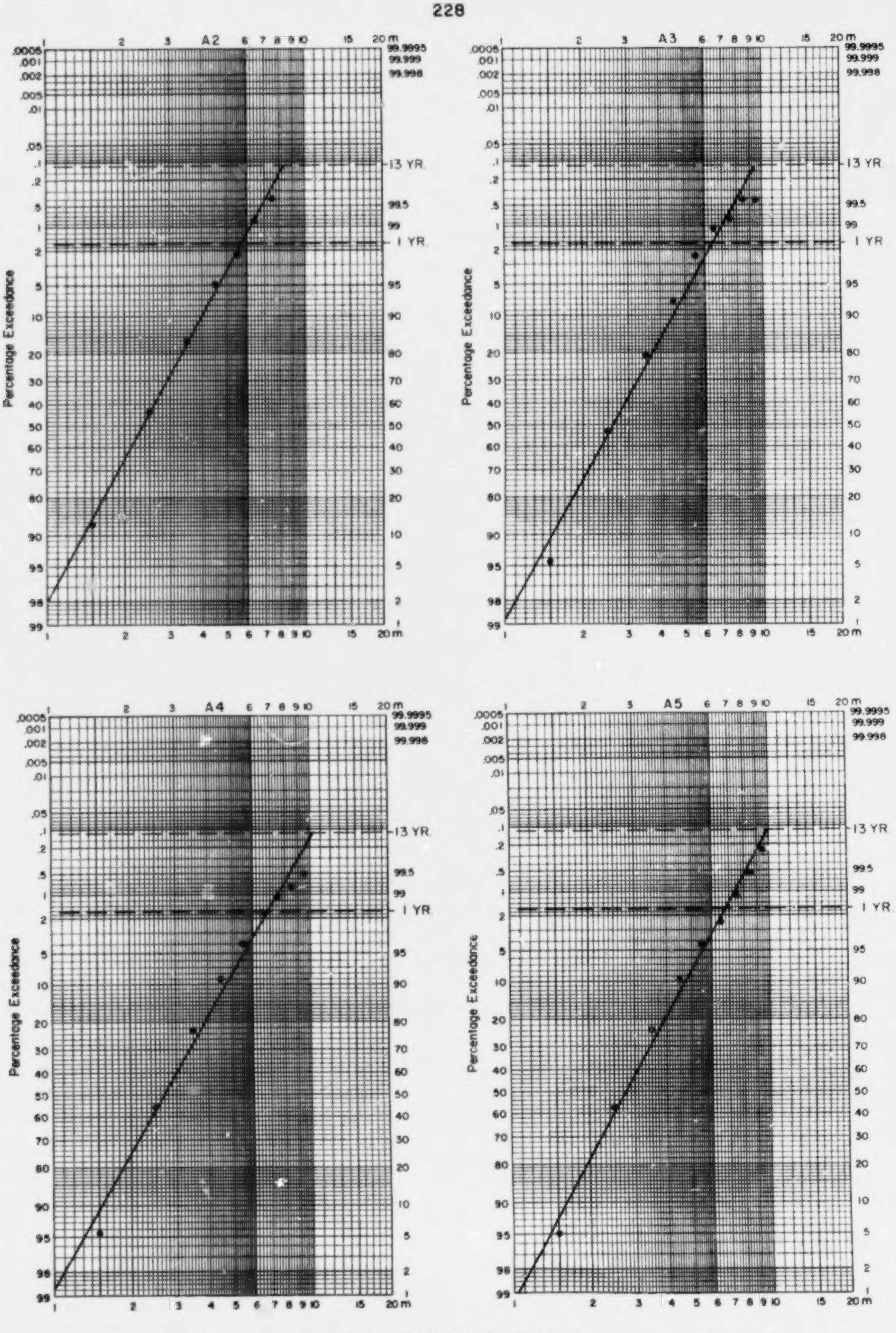


Figure 11c. Monthly Wave Height Exceedance Distribution for November

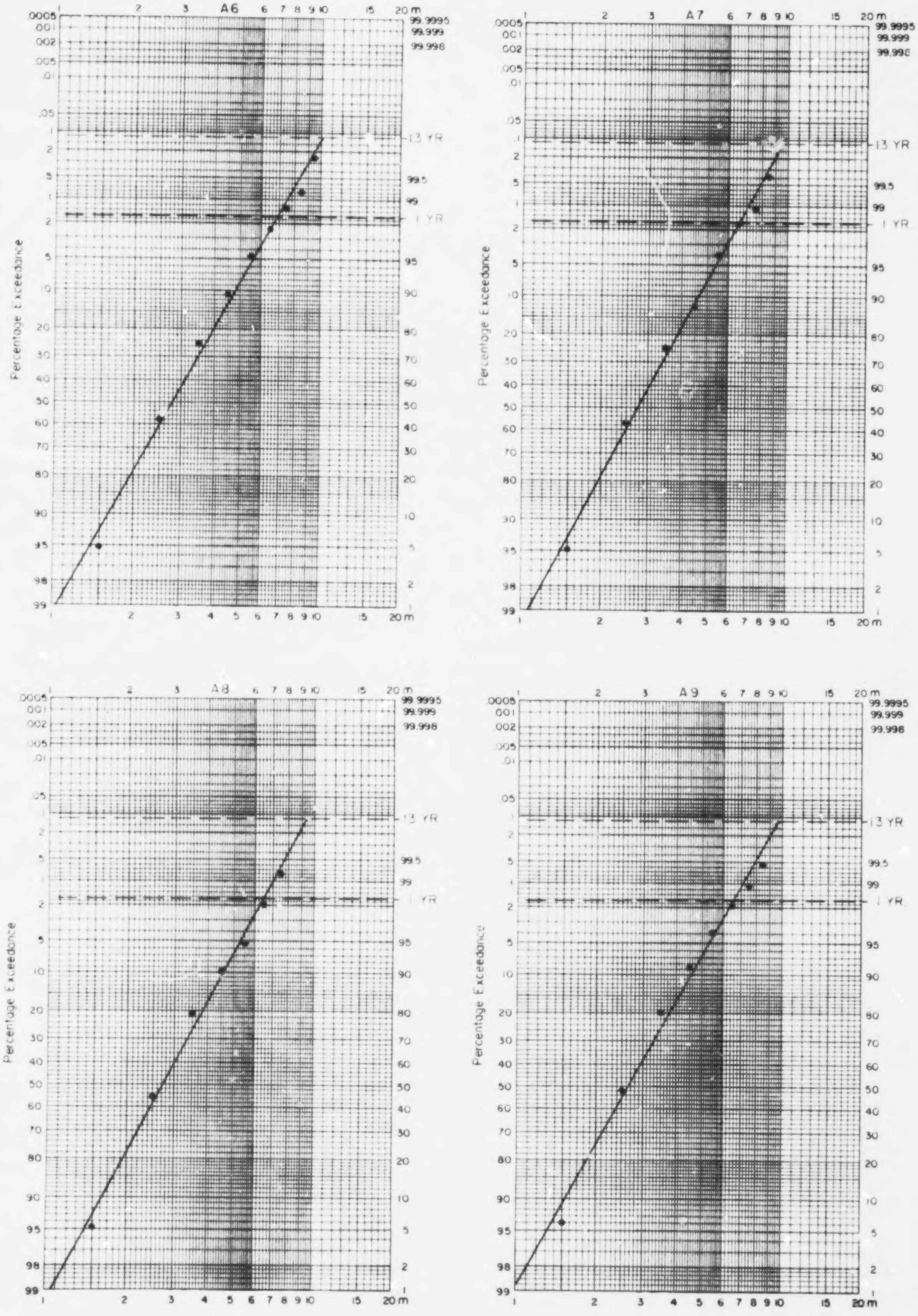
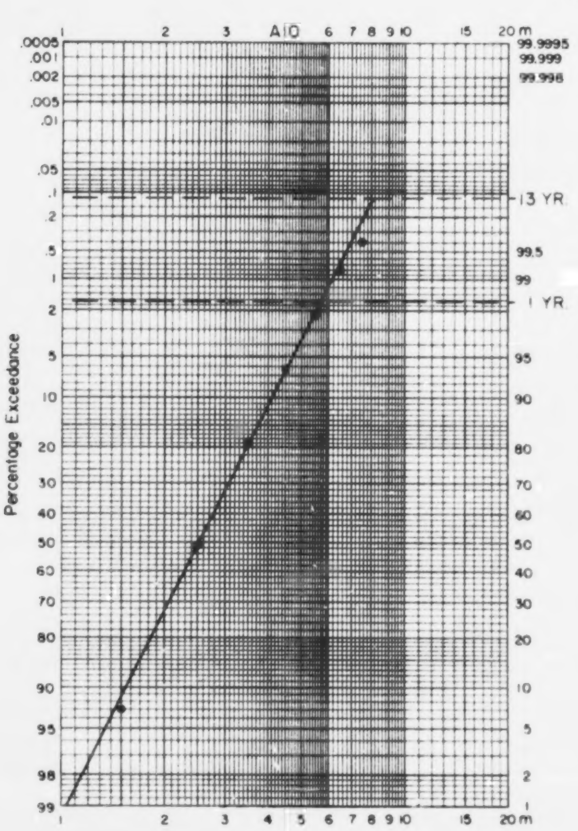
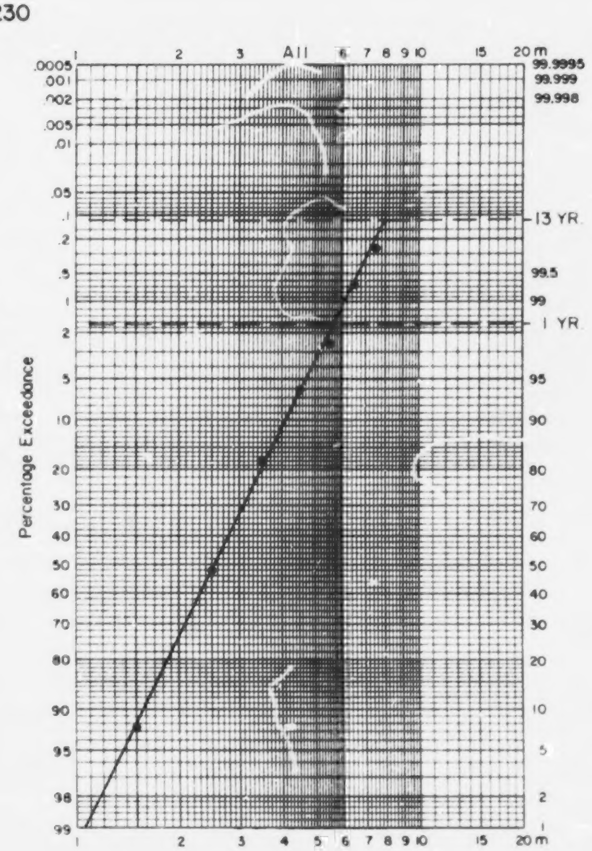
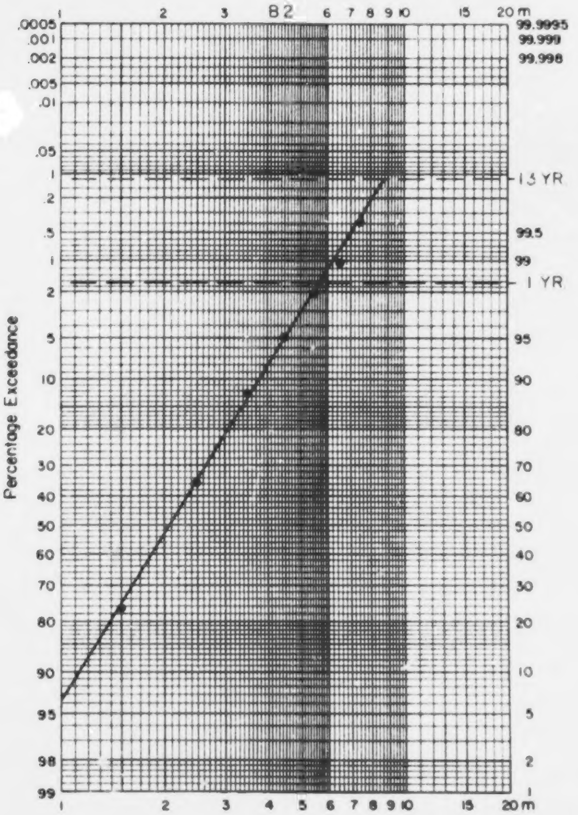


Figure 11d. Monthly Wave Height Exceedance Distribution for November







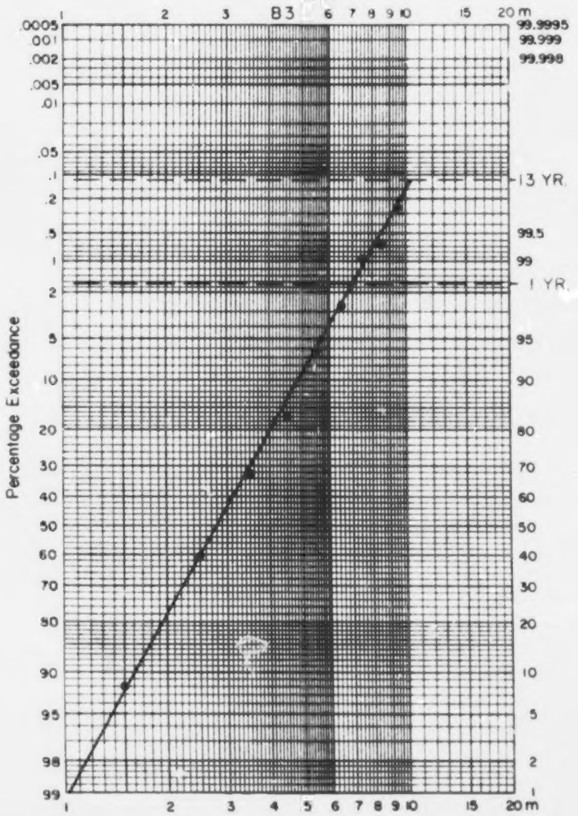


Figure 11e. Monthly Wave Height Exceedance Distribution for November

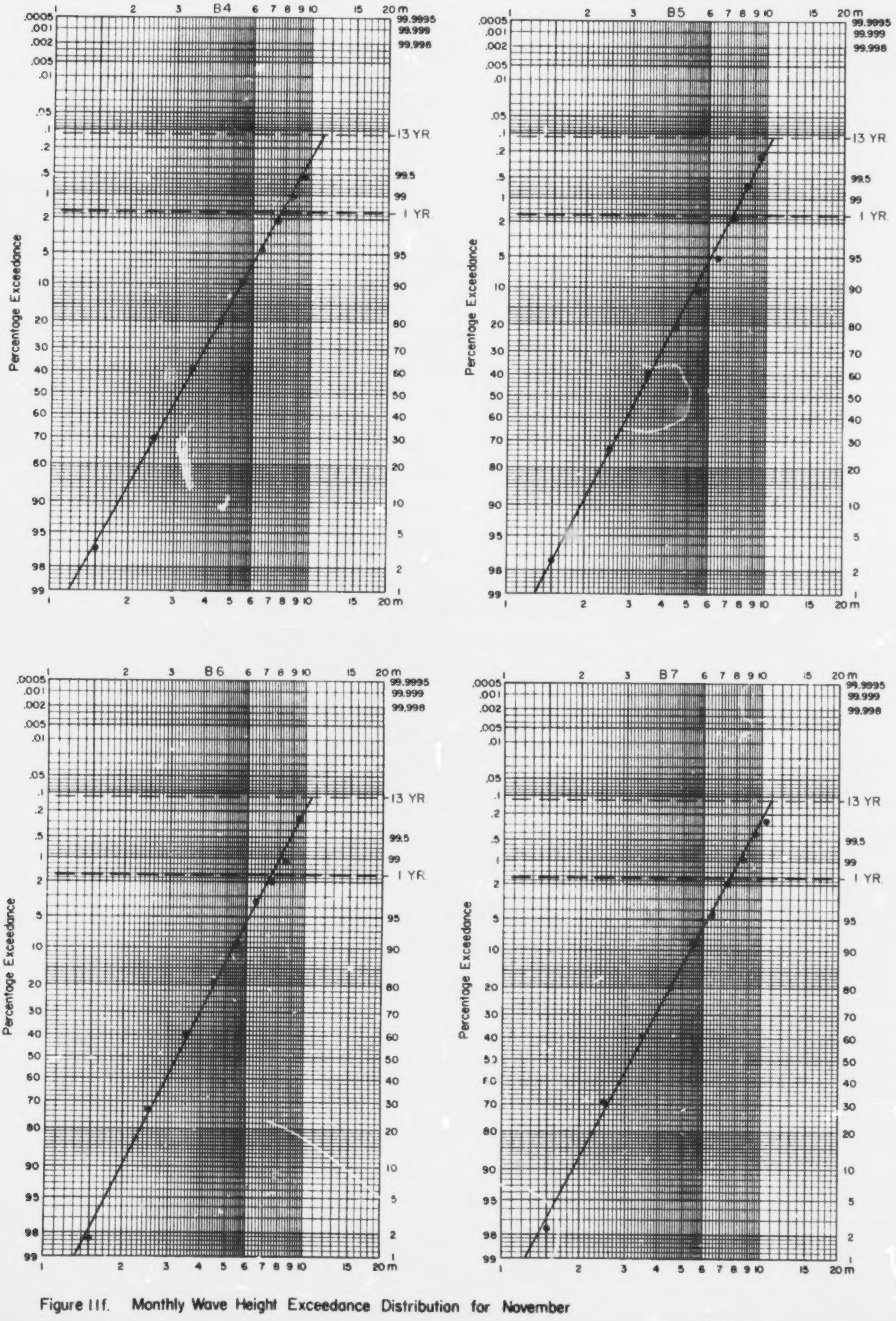


Figure 11f. Monthly Wave Height Exceedance Distribution for November

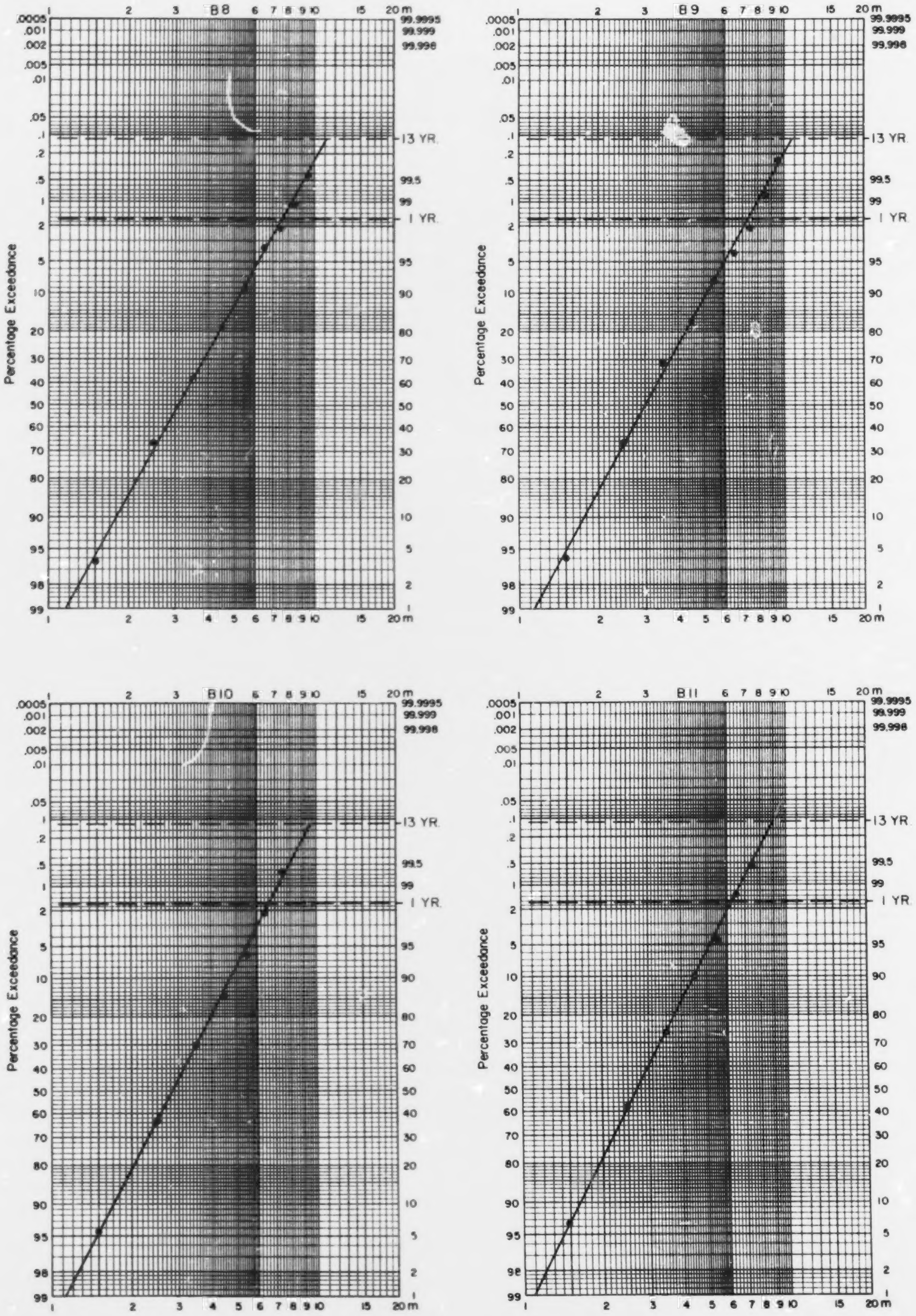


Figure 11g. Monthly Wave Height Exceedance Distribution for November

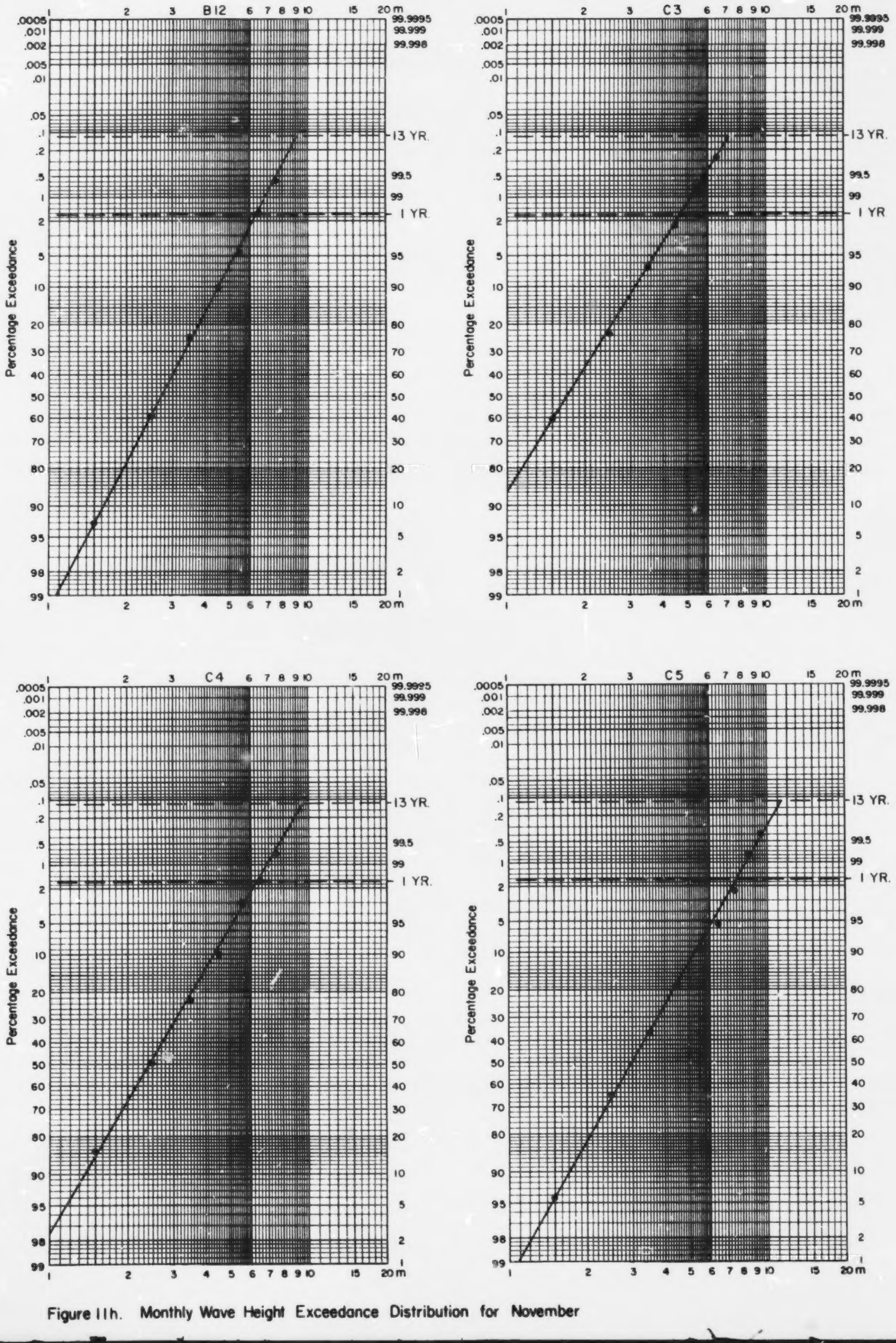


Figure 11h. Monthly Wave Height Exceedance Distribution for November

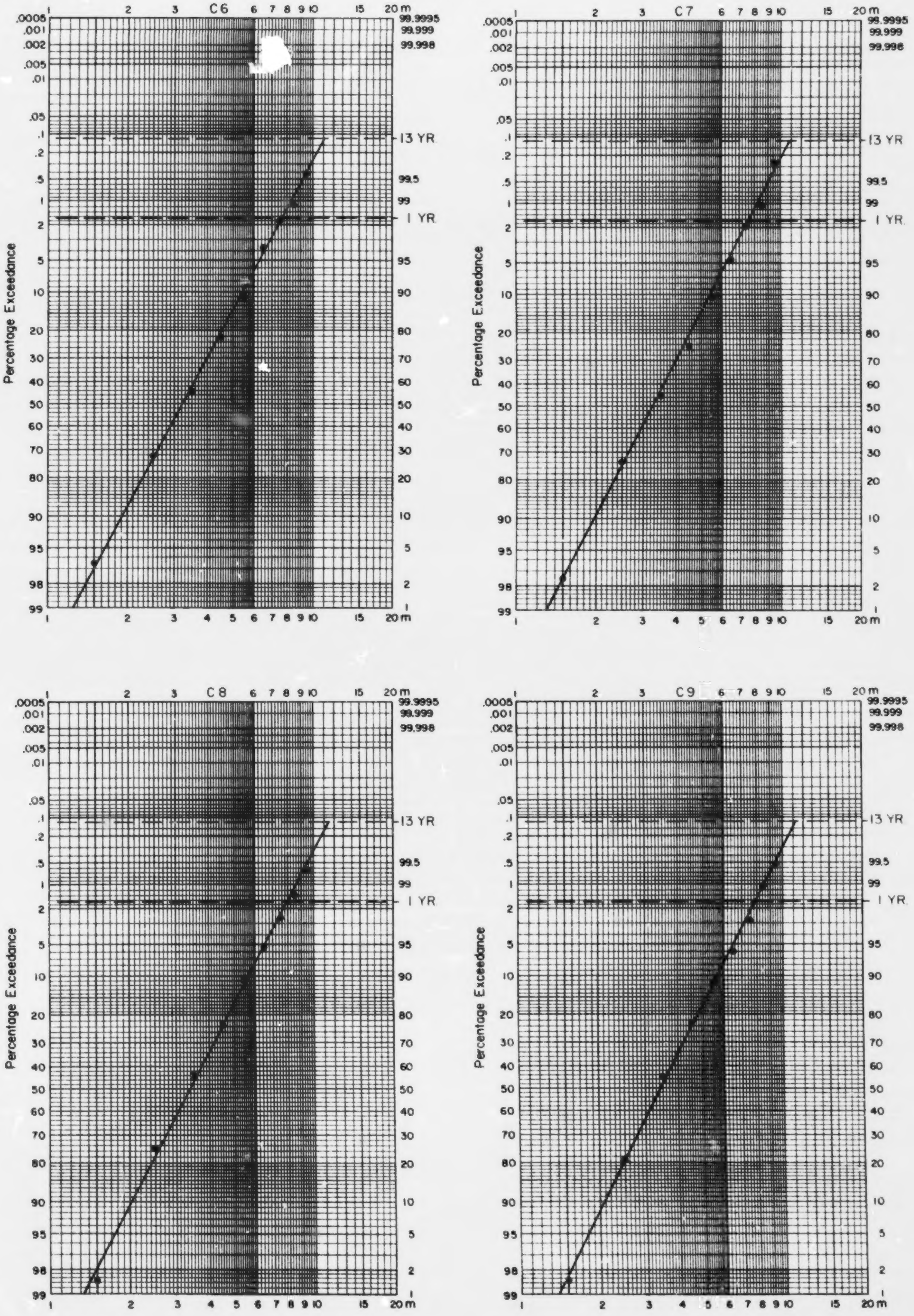


Figure 11i Monthly Wave Height Exceedance Distribution for November

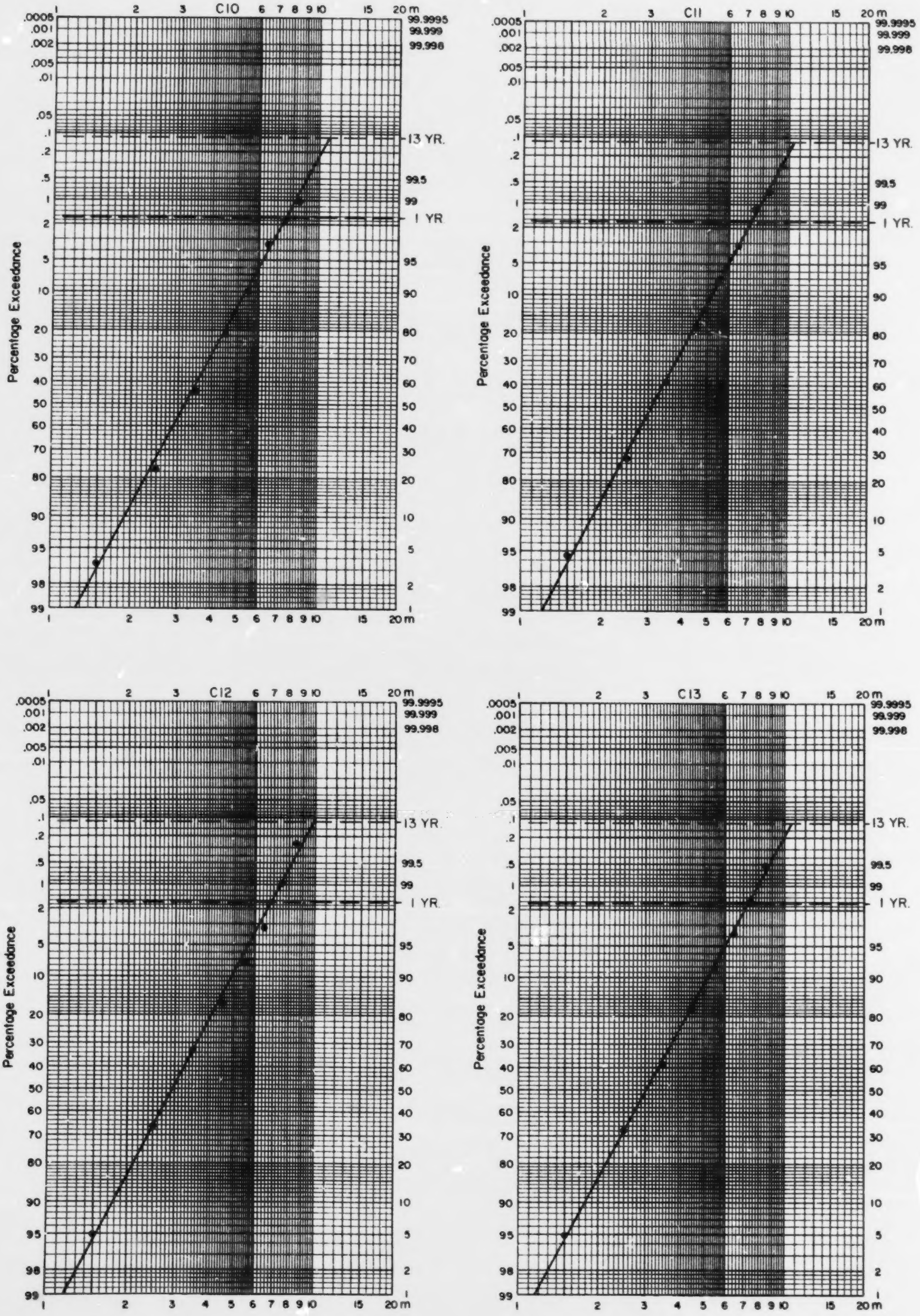


Figure 11j. Monthly Wave Height Exceedance Distribution for November

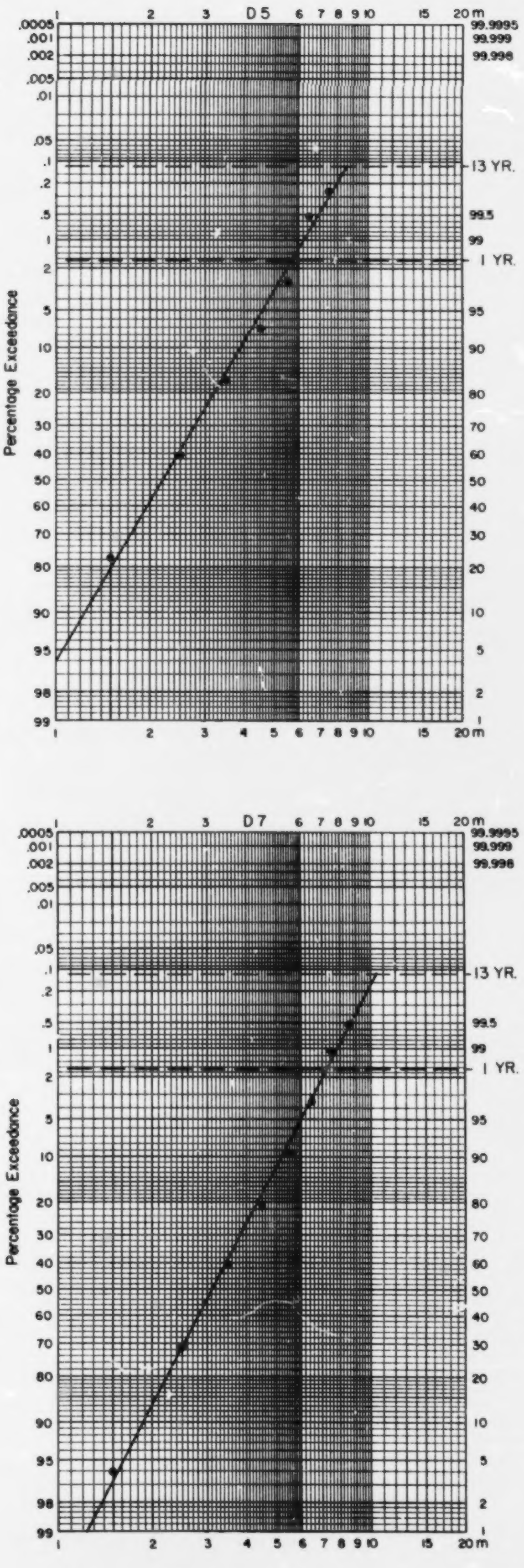


Figure 11k. Monthly Wave Height Exceedance Distribution for November

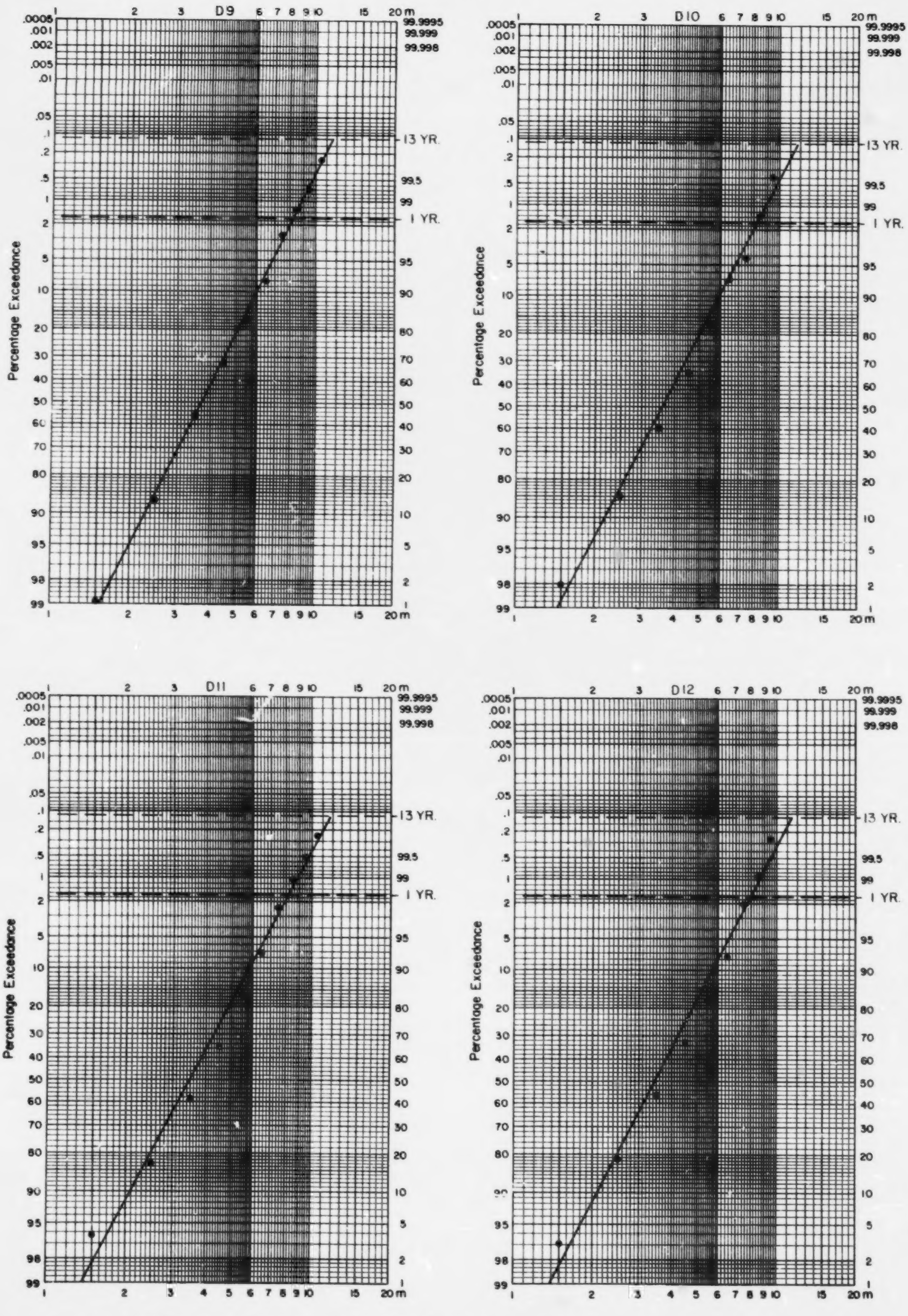


Figure 111. Monthly Wave Height Exceedance Distribution for November

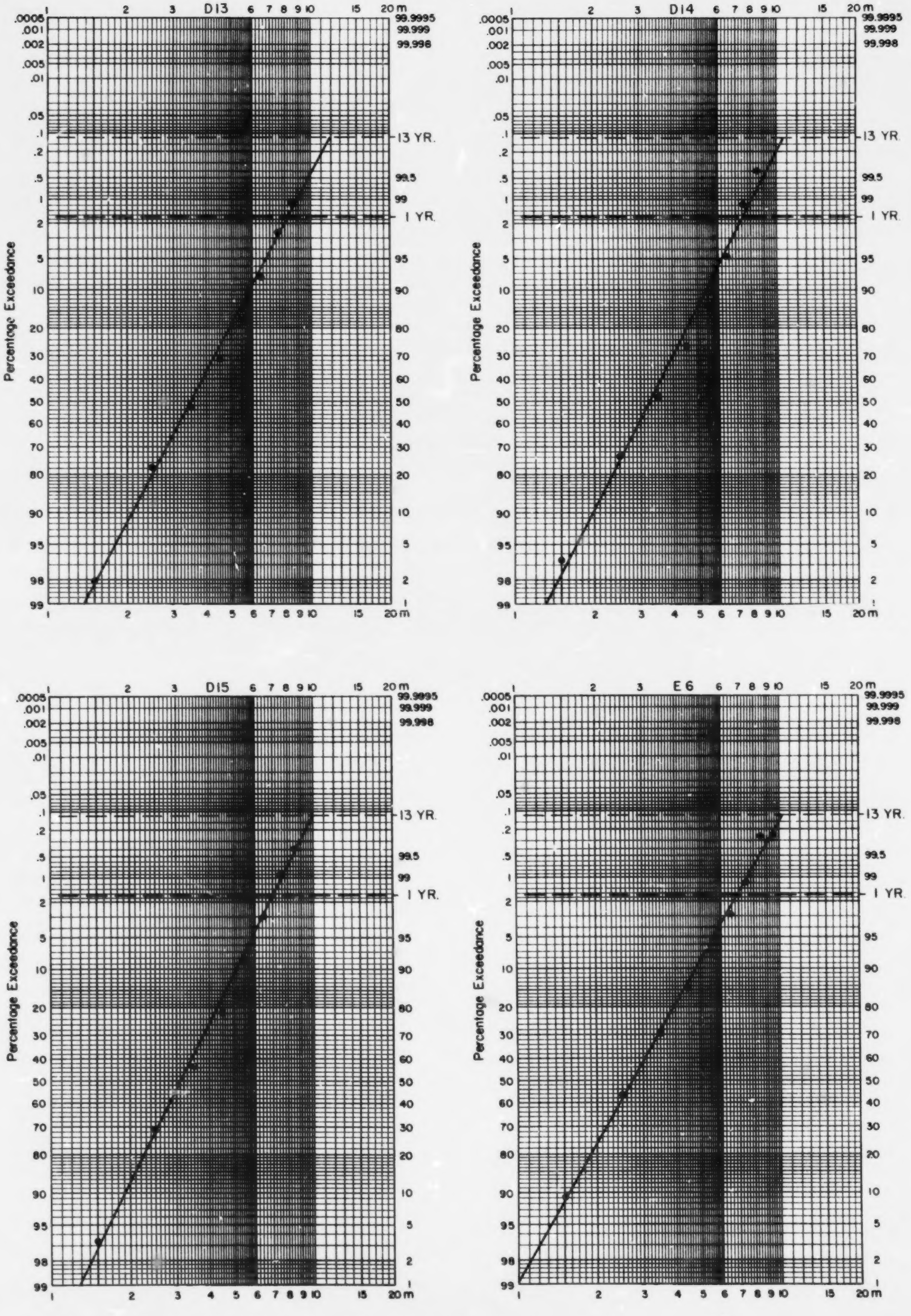


Figure 11m. Monthly Wave Height Exceedance Distribution for November

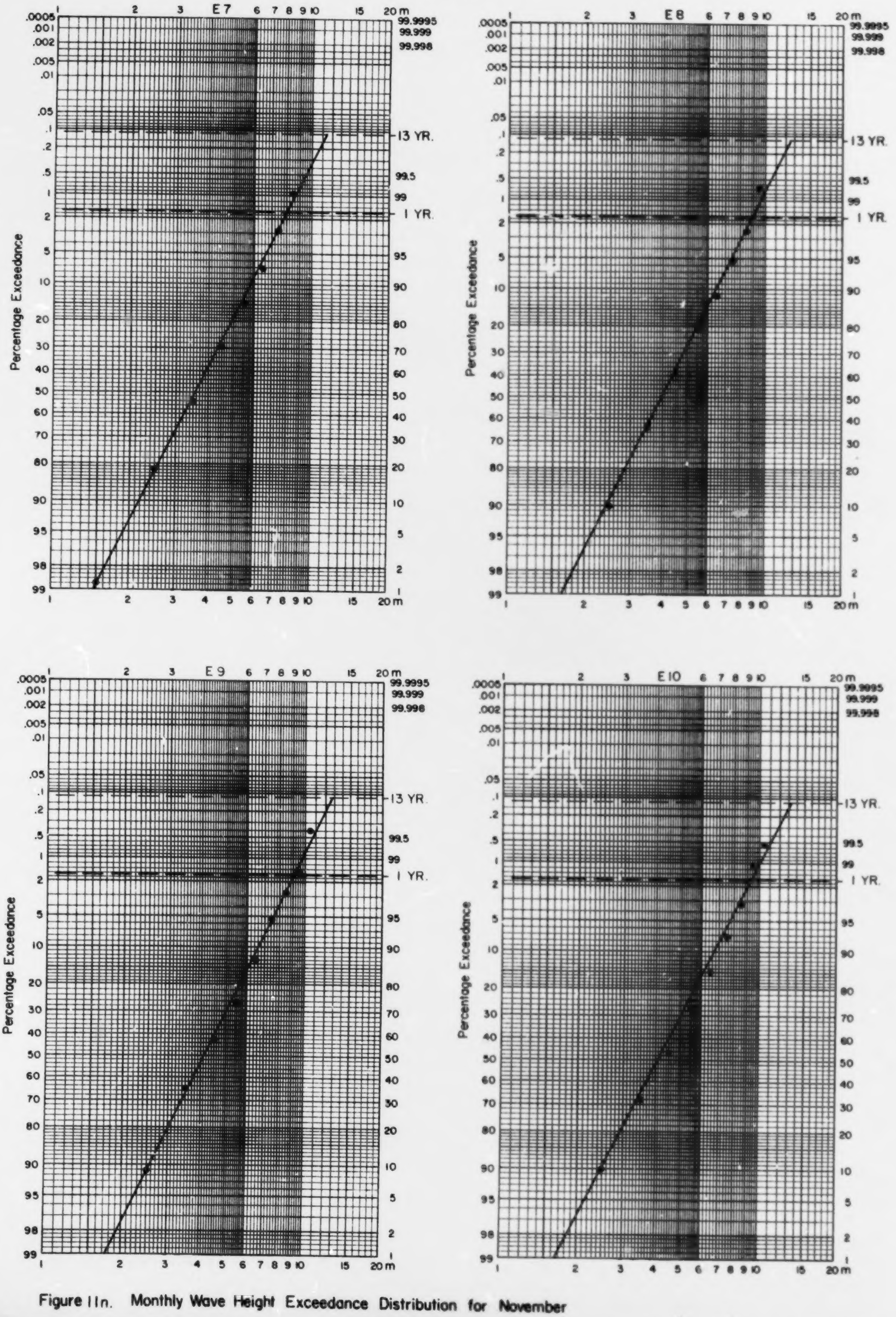
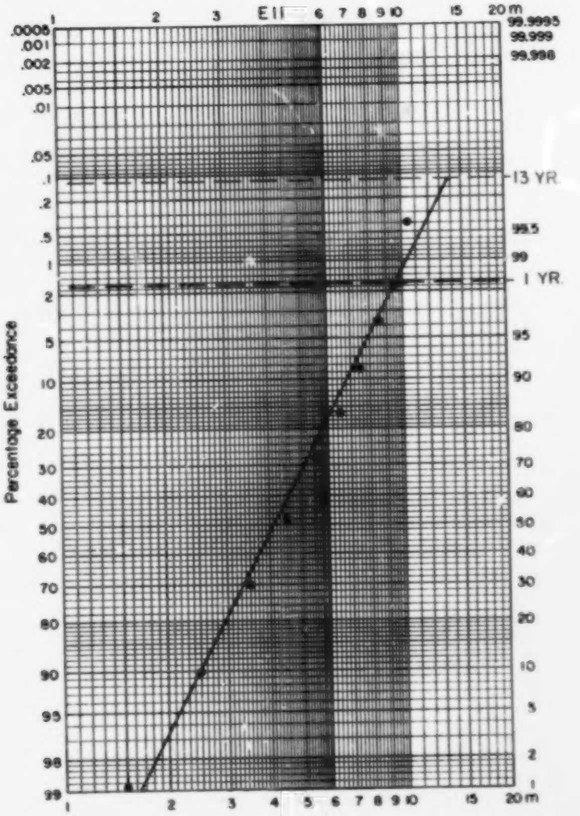
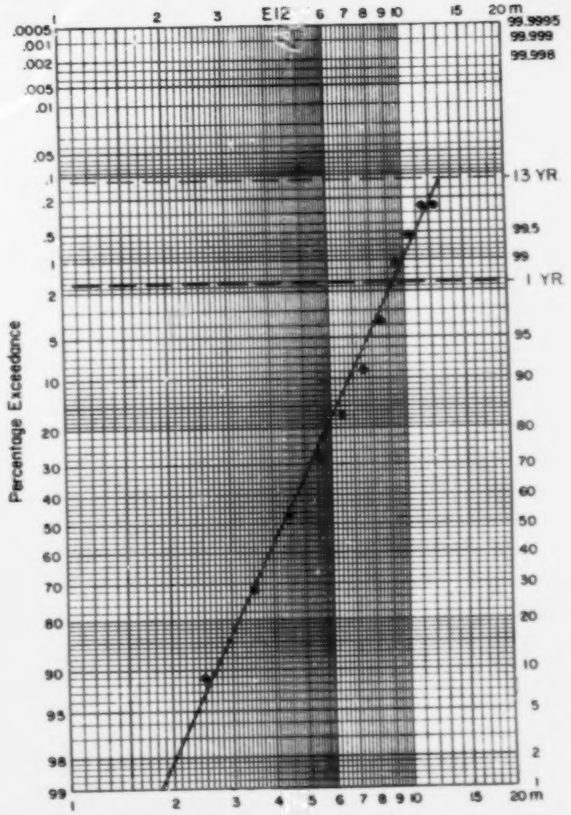
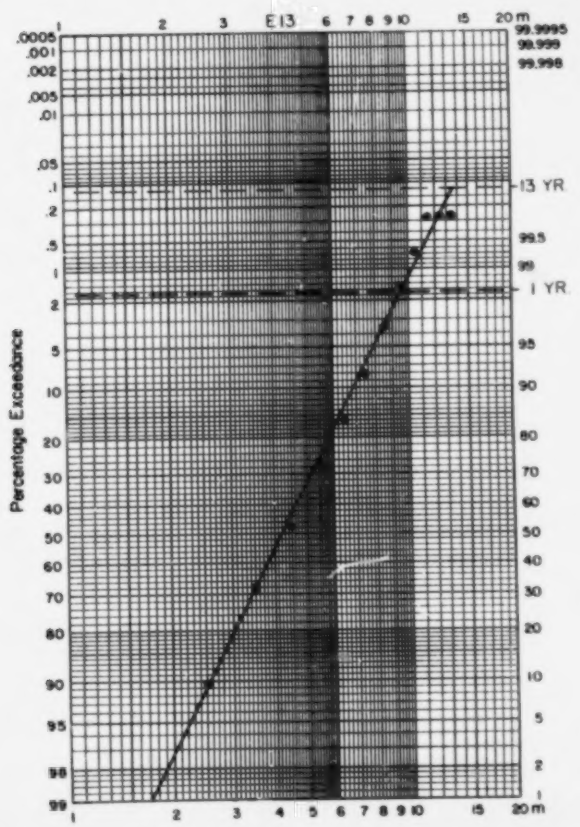


Figure 11n. Monthly Wave Height Exceedance Distribution for November







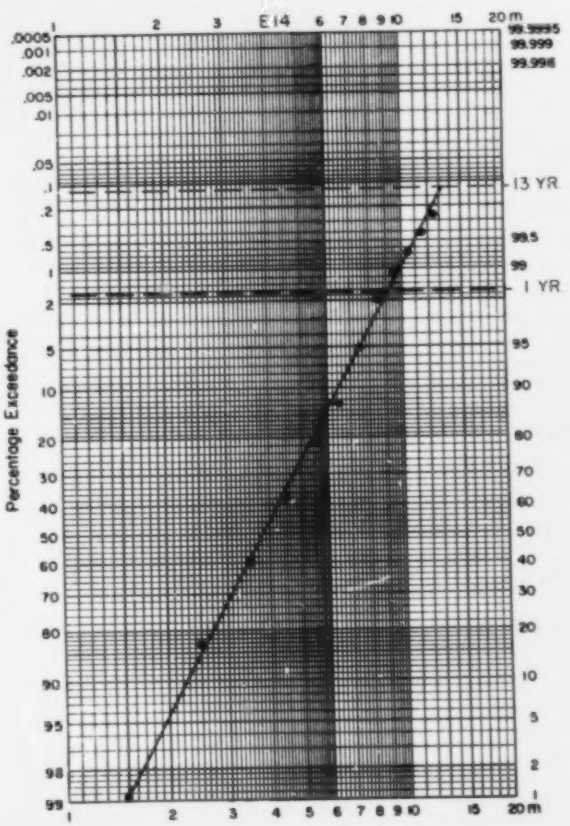


Figure 11o. Monthly Wave Height Exceedance Distribution for November

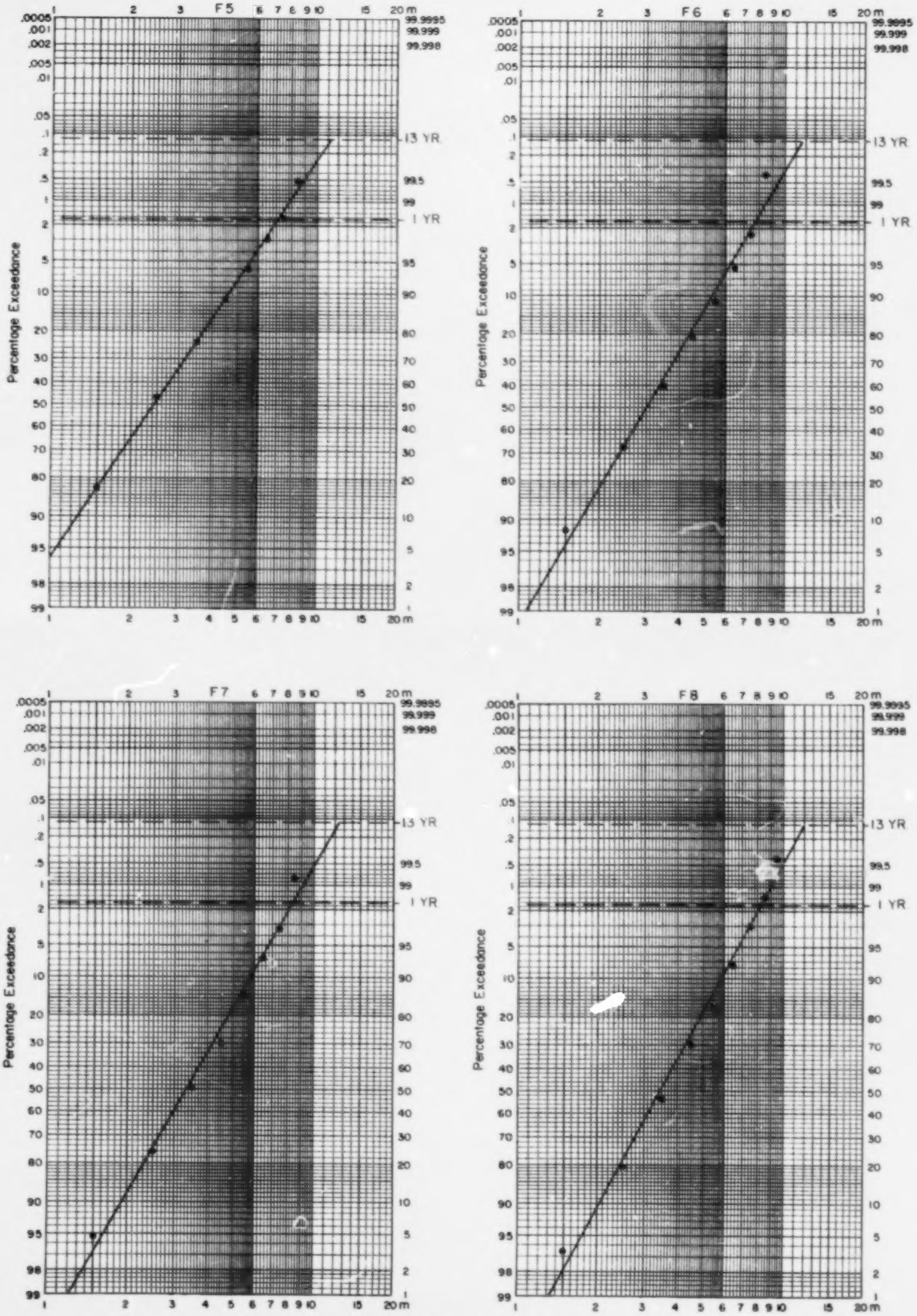


Figure 11p. Monthly Wave Height Exceedance Distribution for November

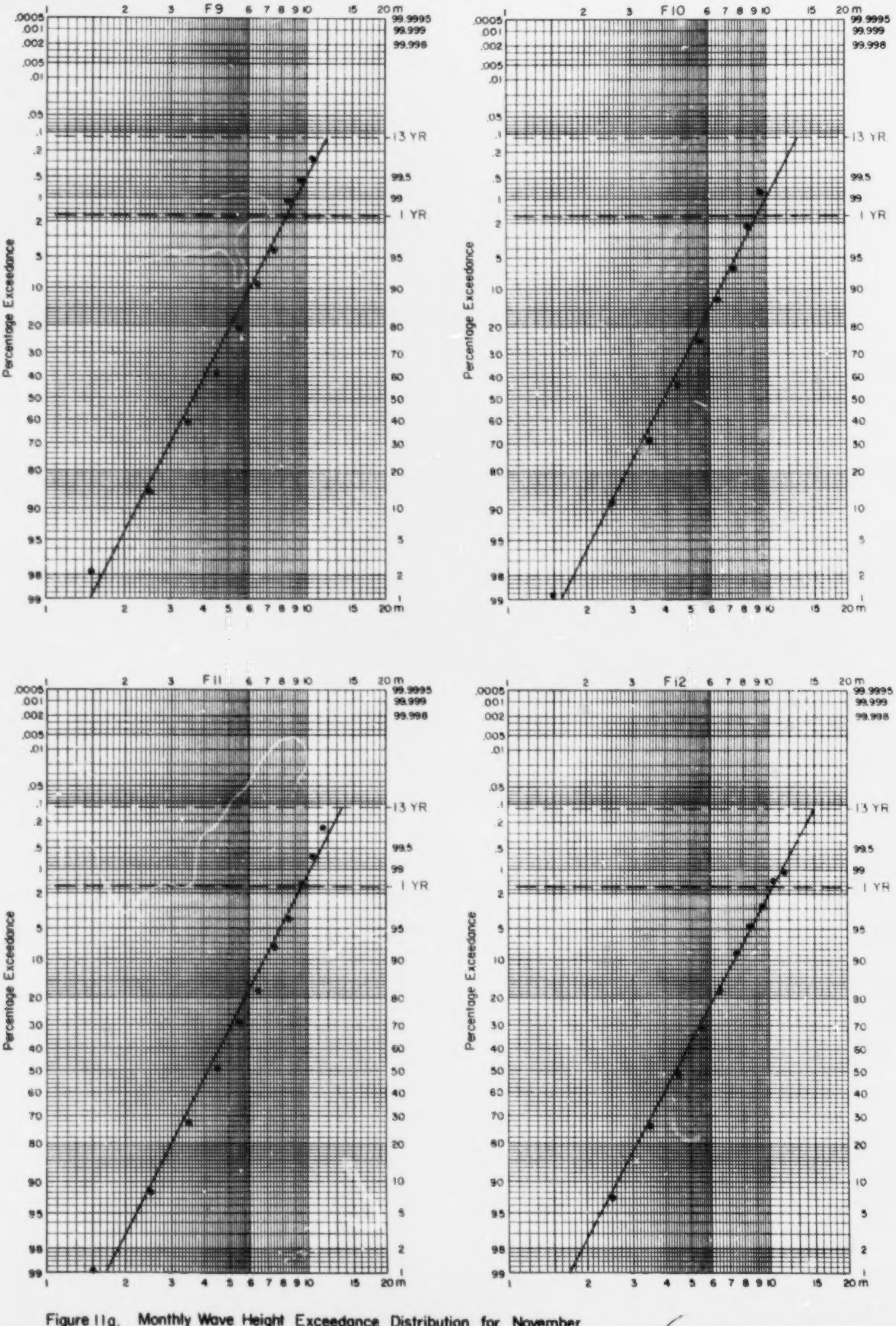


Figure 11q. Monthly Wave Height Exceedance Distribution for November

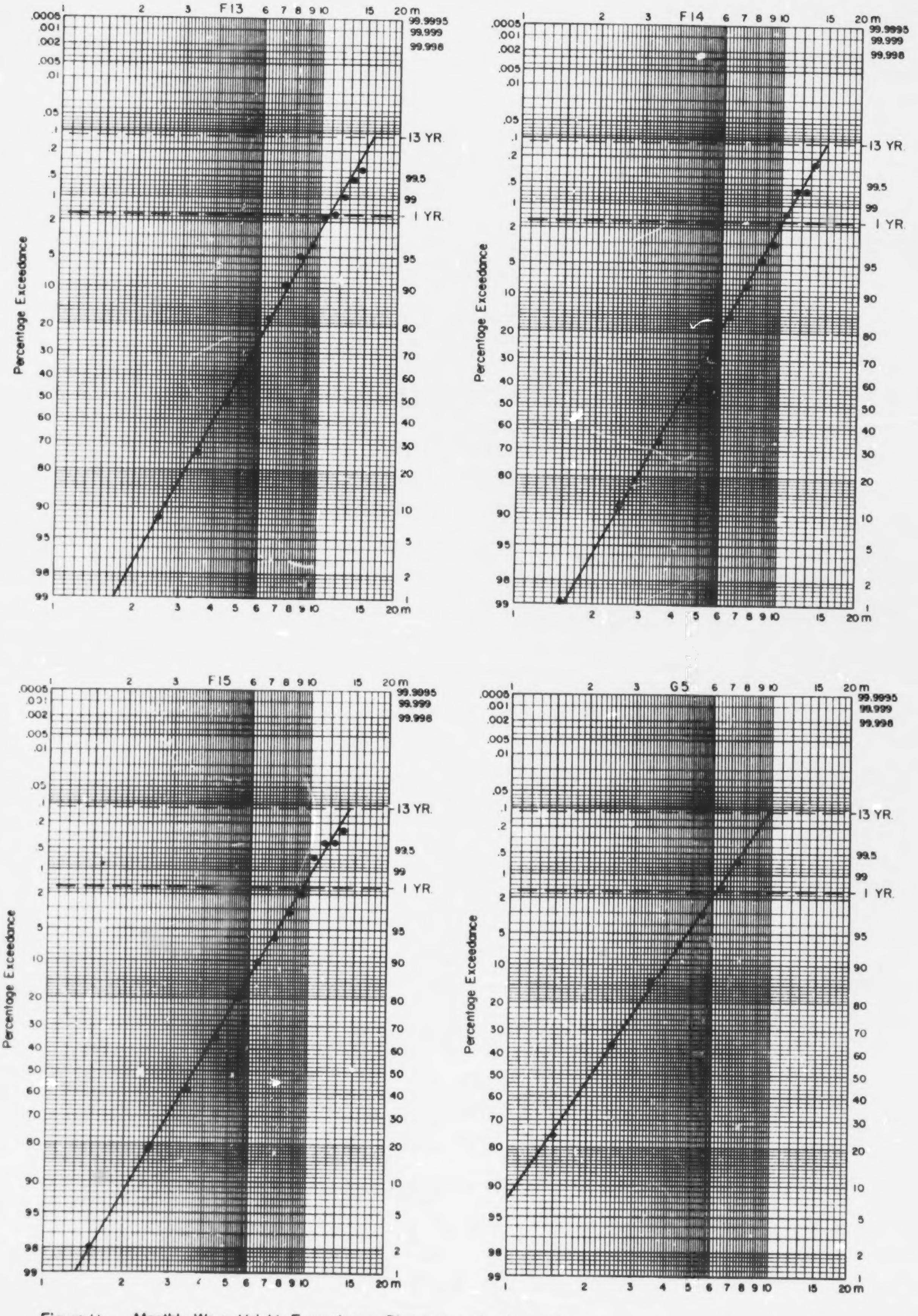


Figure 11r. Monthly Wave Height Exceedance Distribution for November

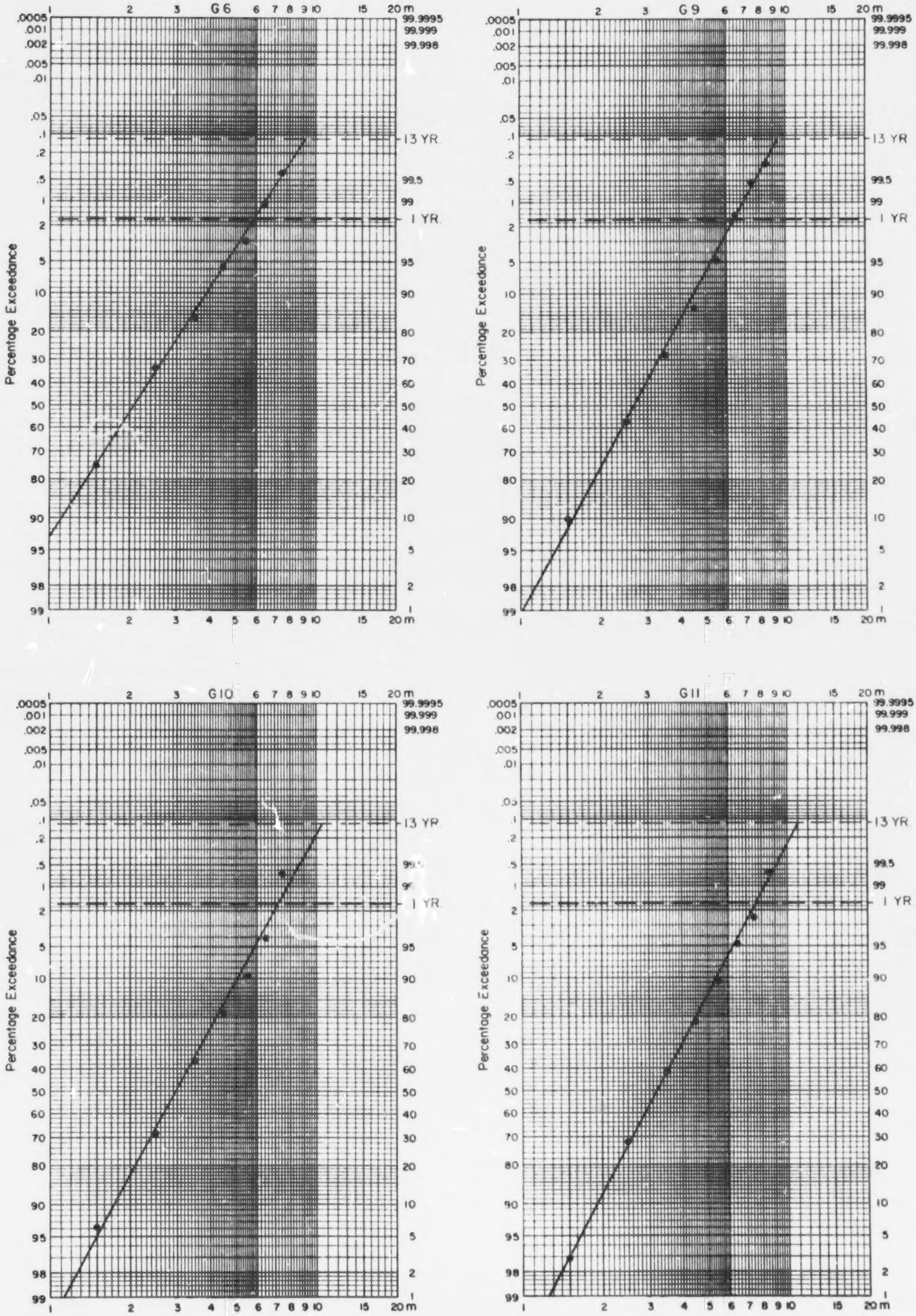


Figure 11s. Monthly Wave Height Exceedance Distribution for November

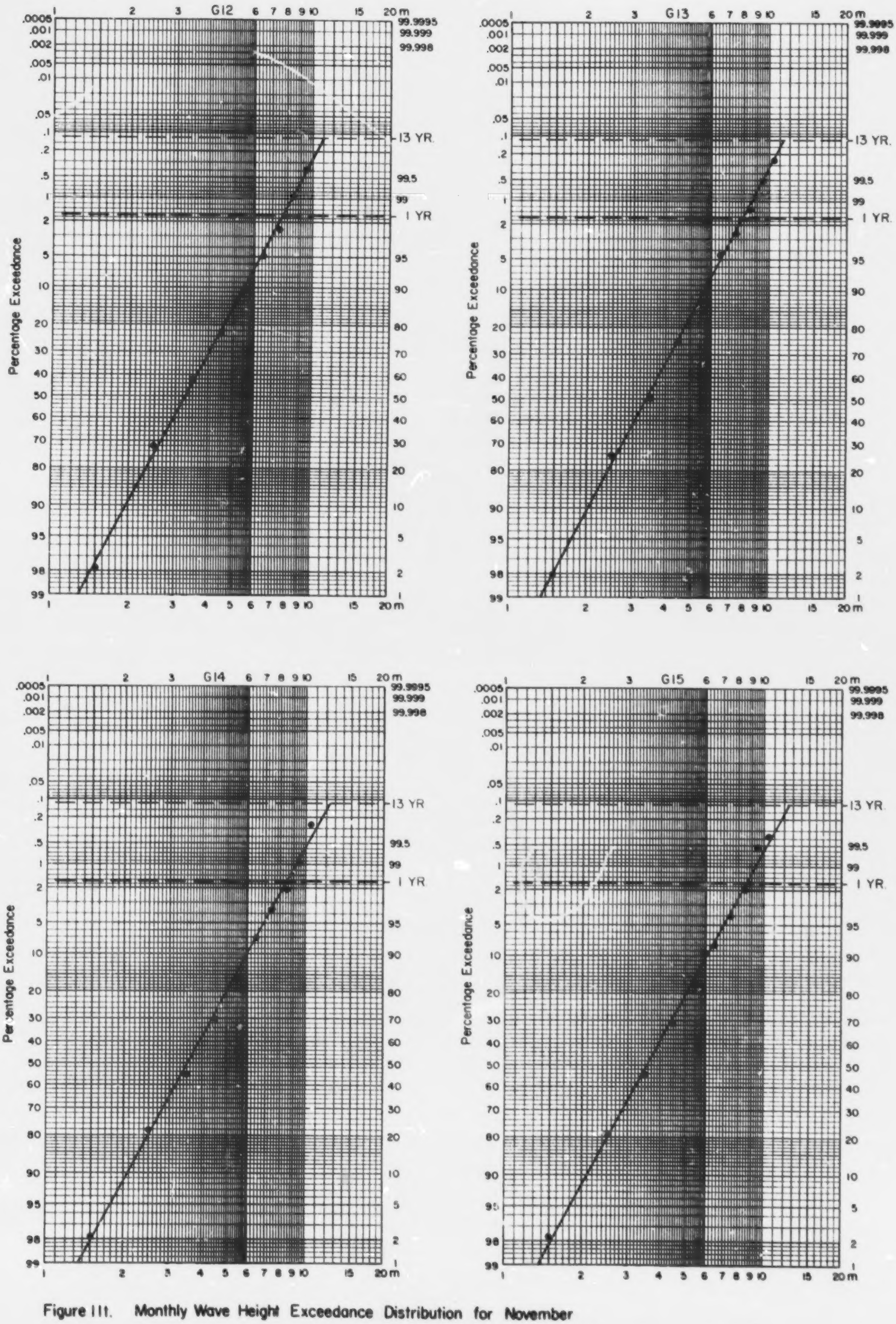


Figure 111. Monthly Wave Height Exceedance Distribution for November

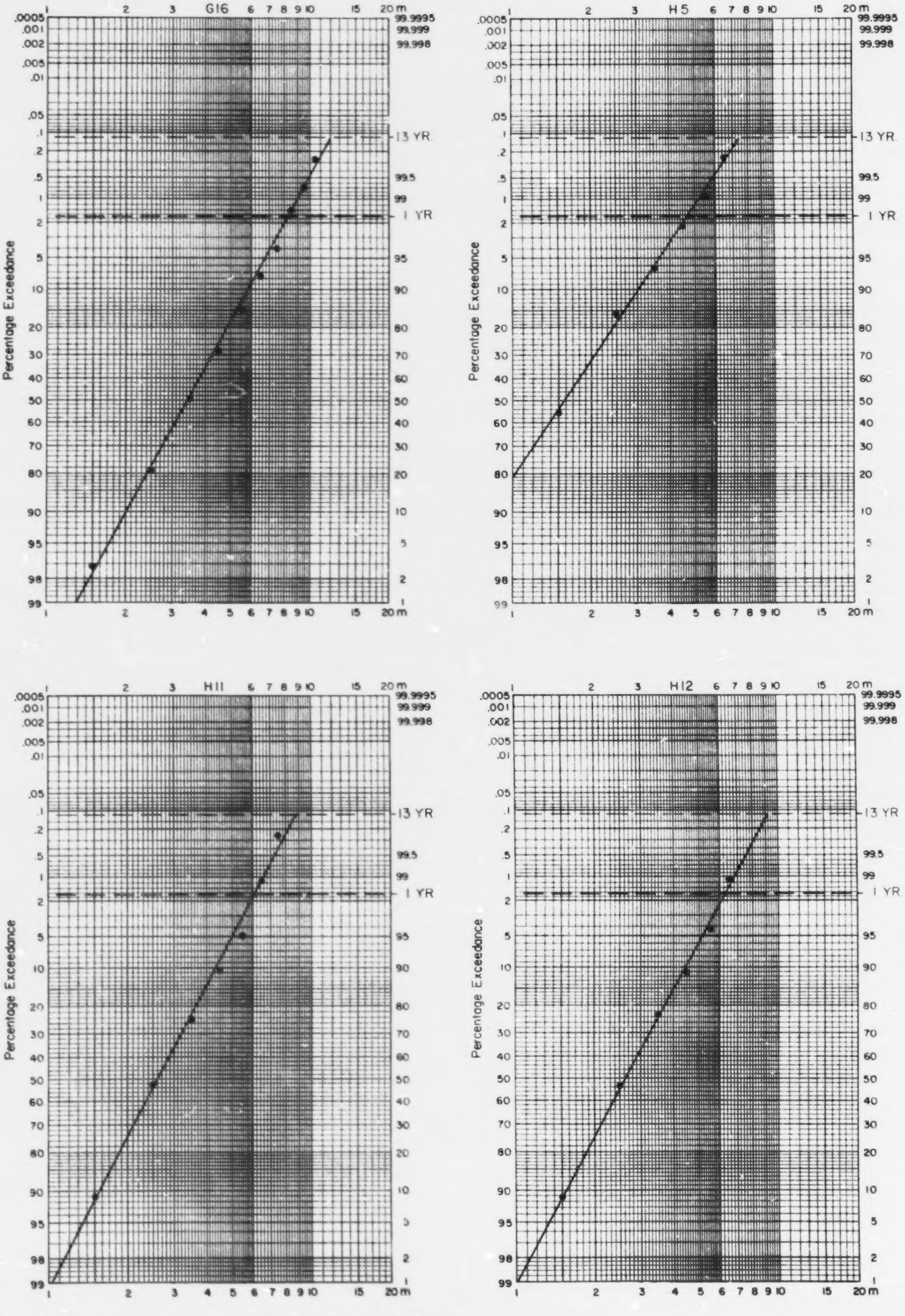


Figure 11u. Monthly Wave Height Exceedance Distribution for November

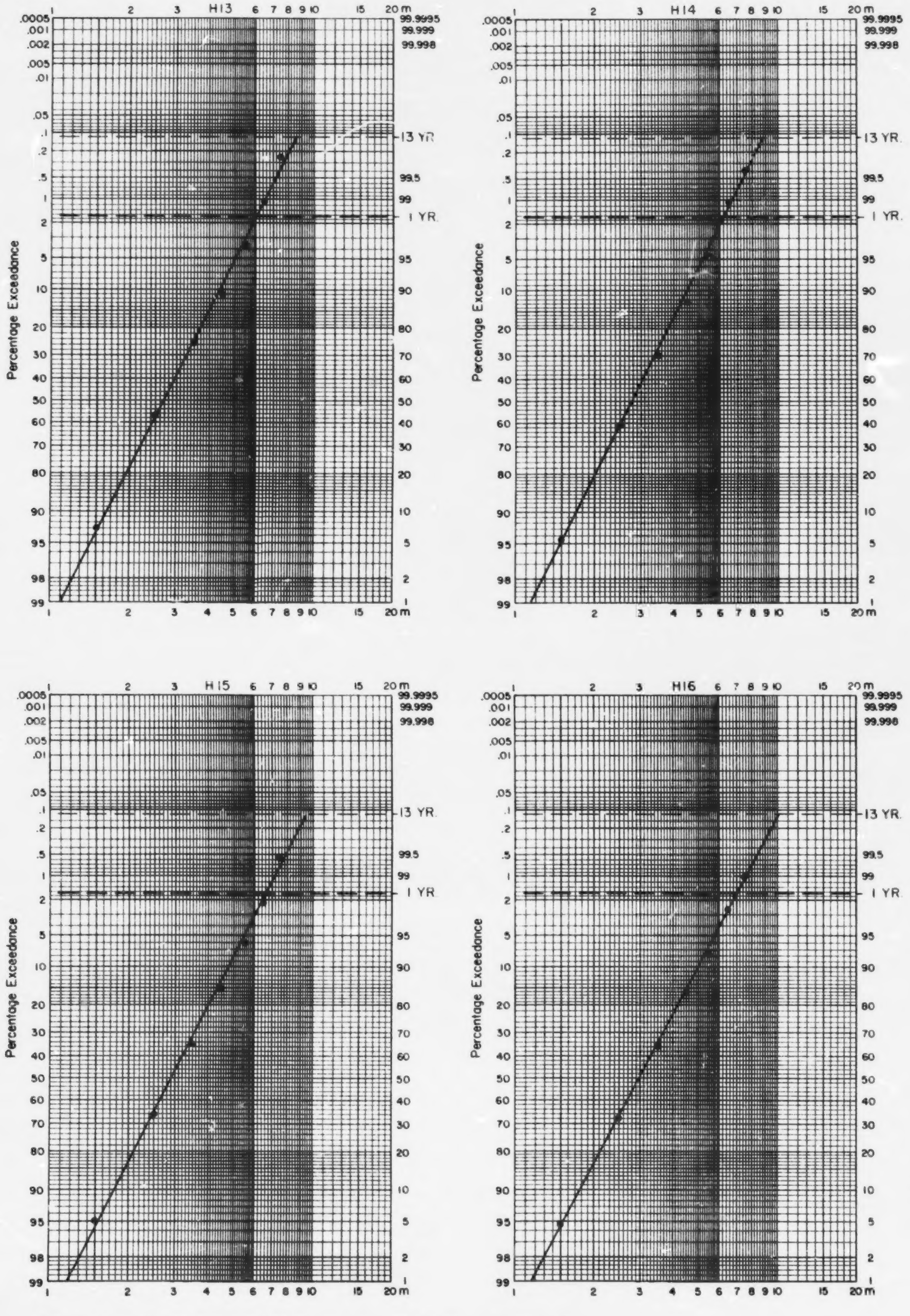


Figure 11v. Monthly Wave Height Exceedance Distribution for November

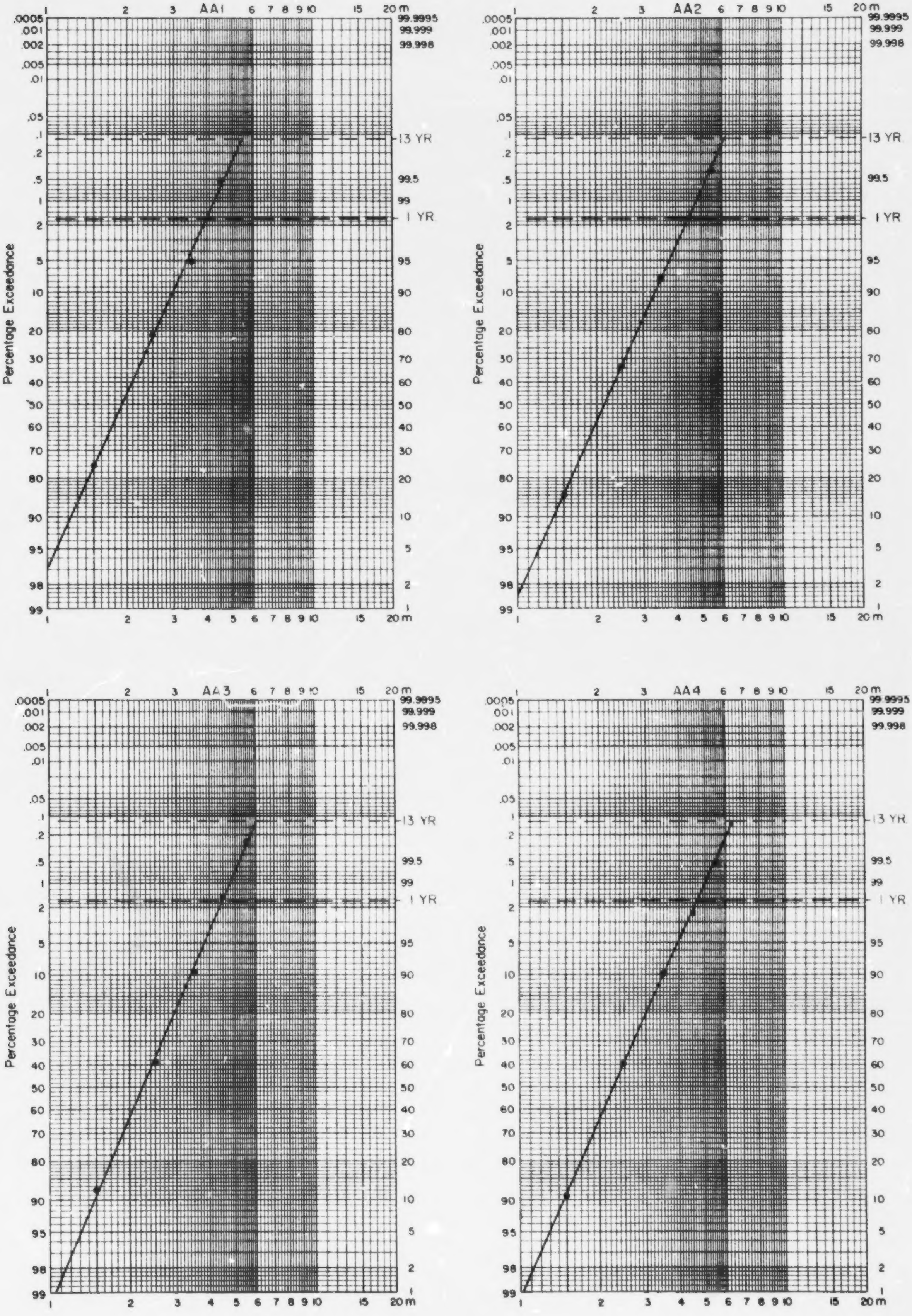


Figure 12a. Monthly Wave Height Exceedance Distribution for December

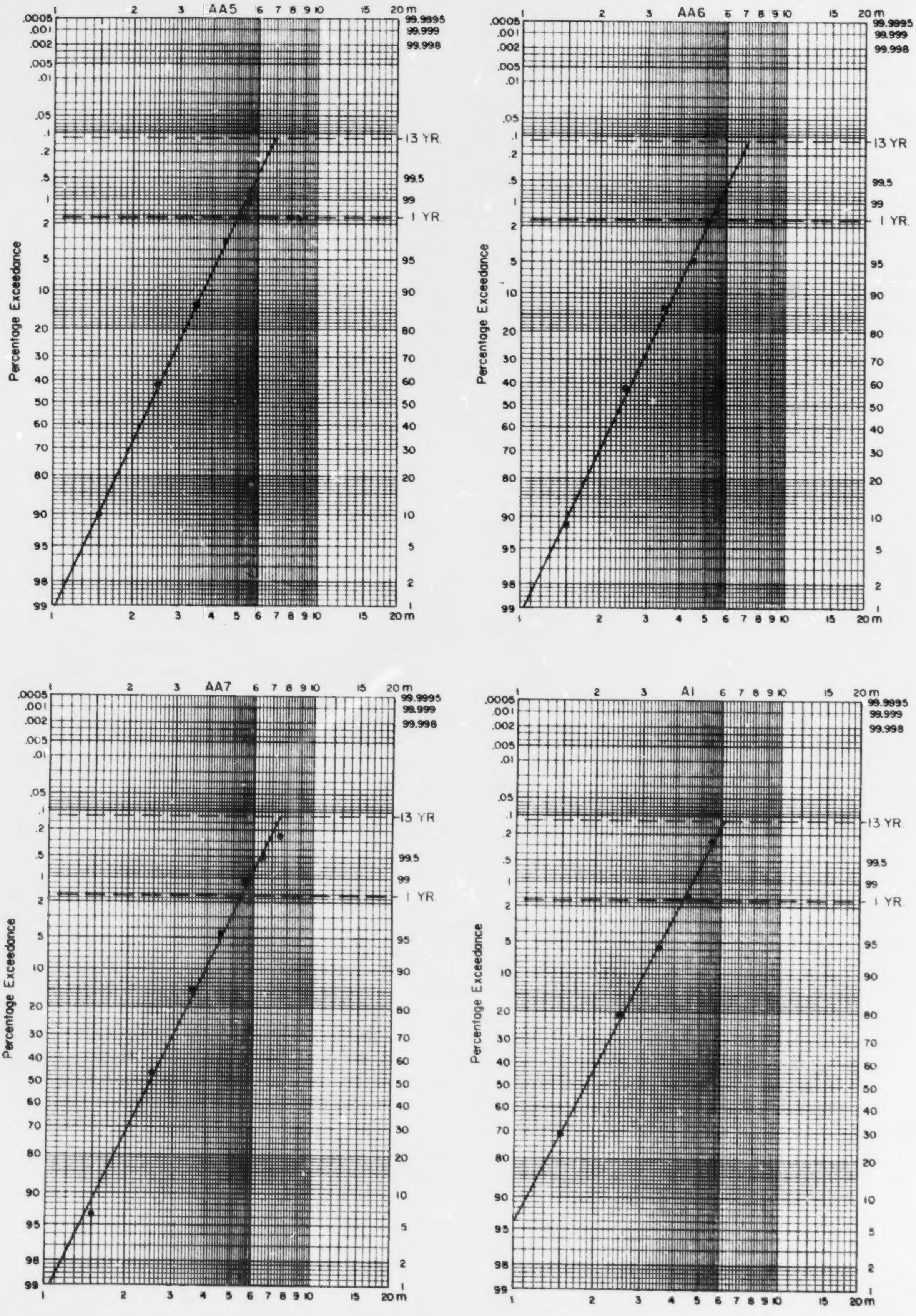


Figure 12 b. Monthly Wave Height Exceedance Distribution for December

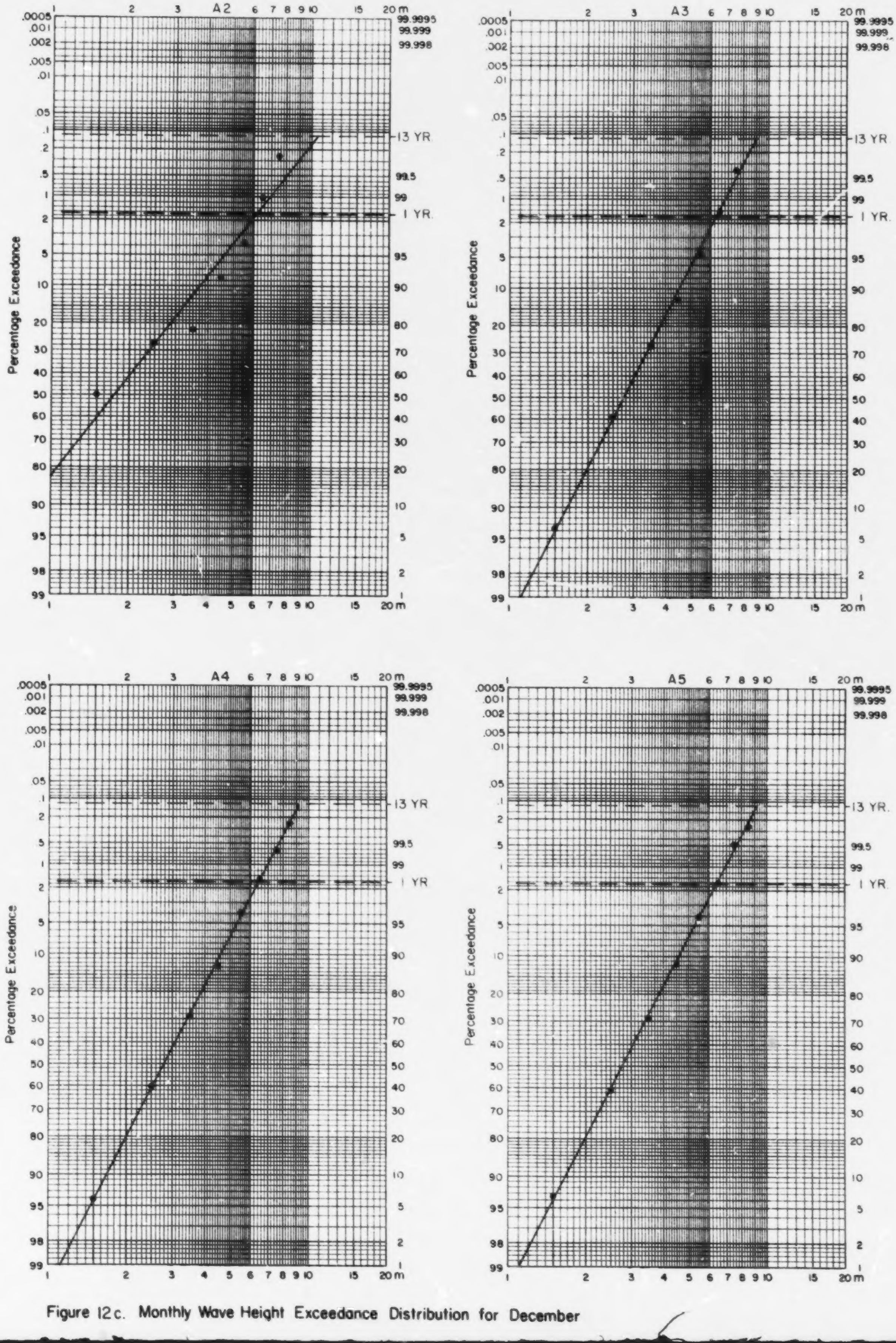


Figure 12c. Monthly Wave Height Exceedance Distribution for December

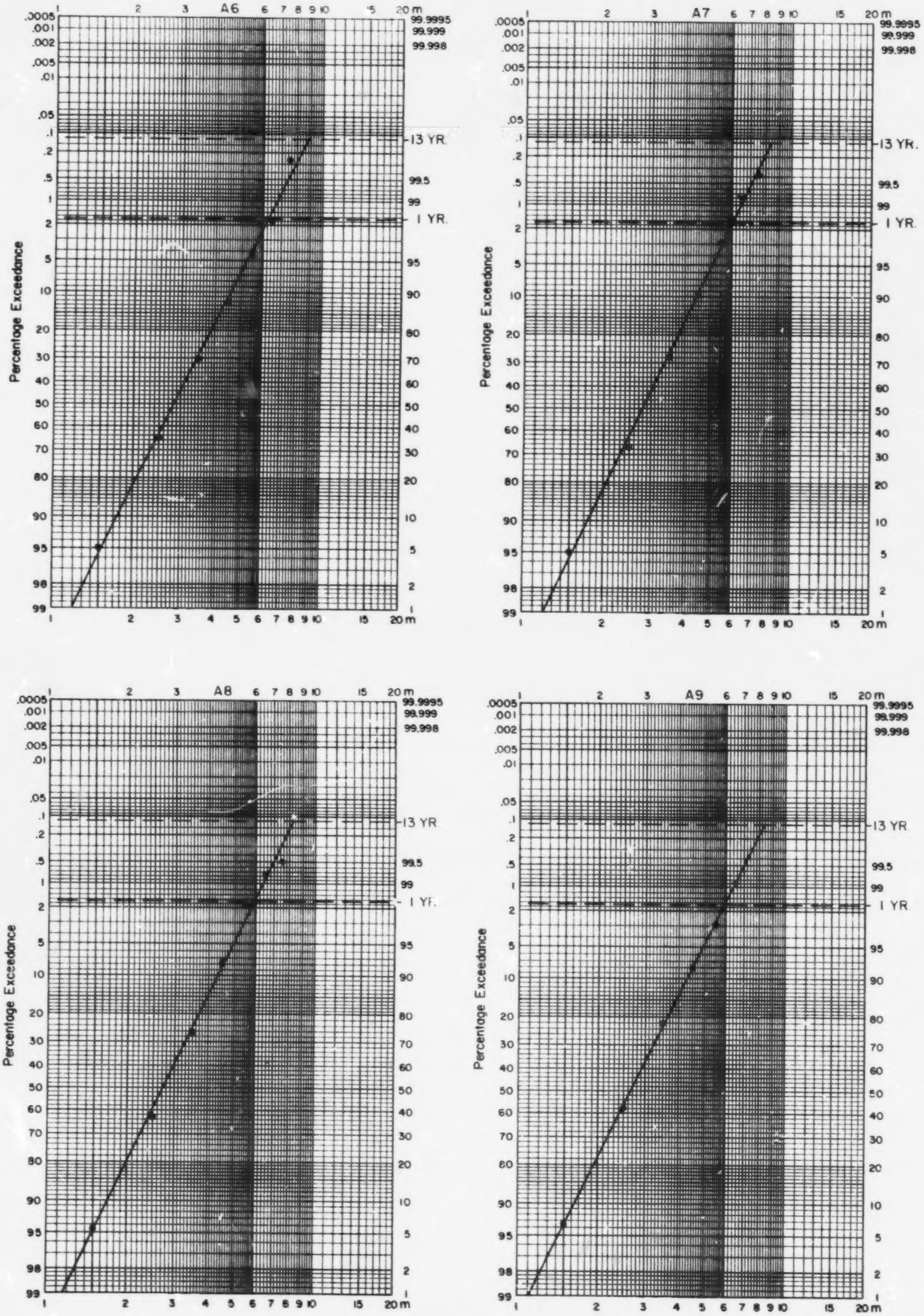


Figure 12d. Monthly Wave Height Exceedance Distribution for December

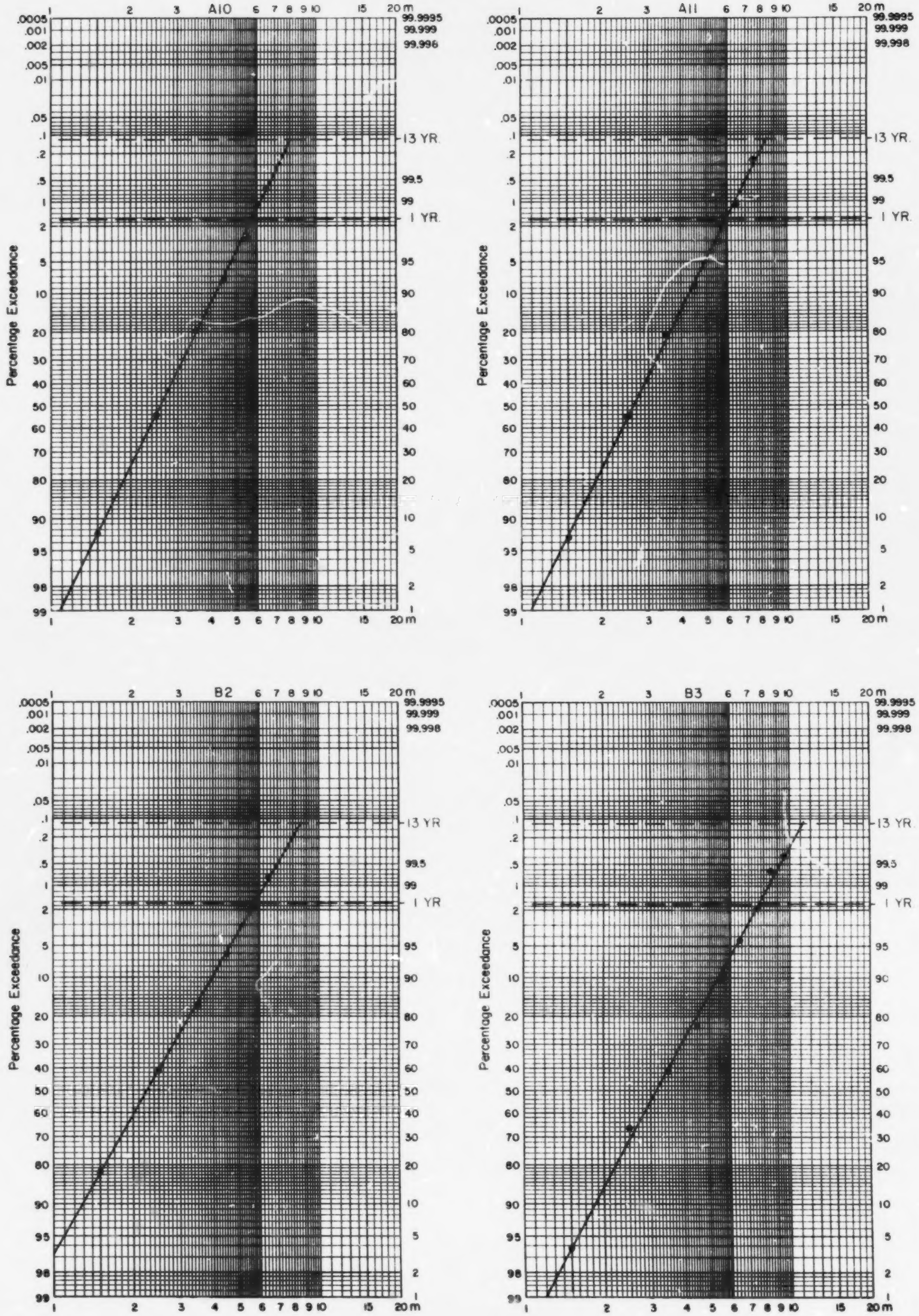


Figure 12e. Monthly Wave Height Exceedance Distribution for December

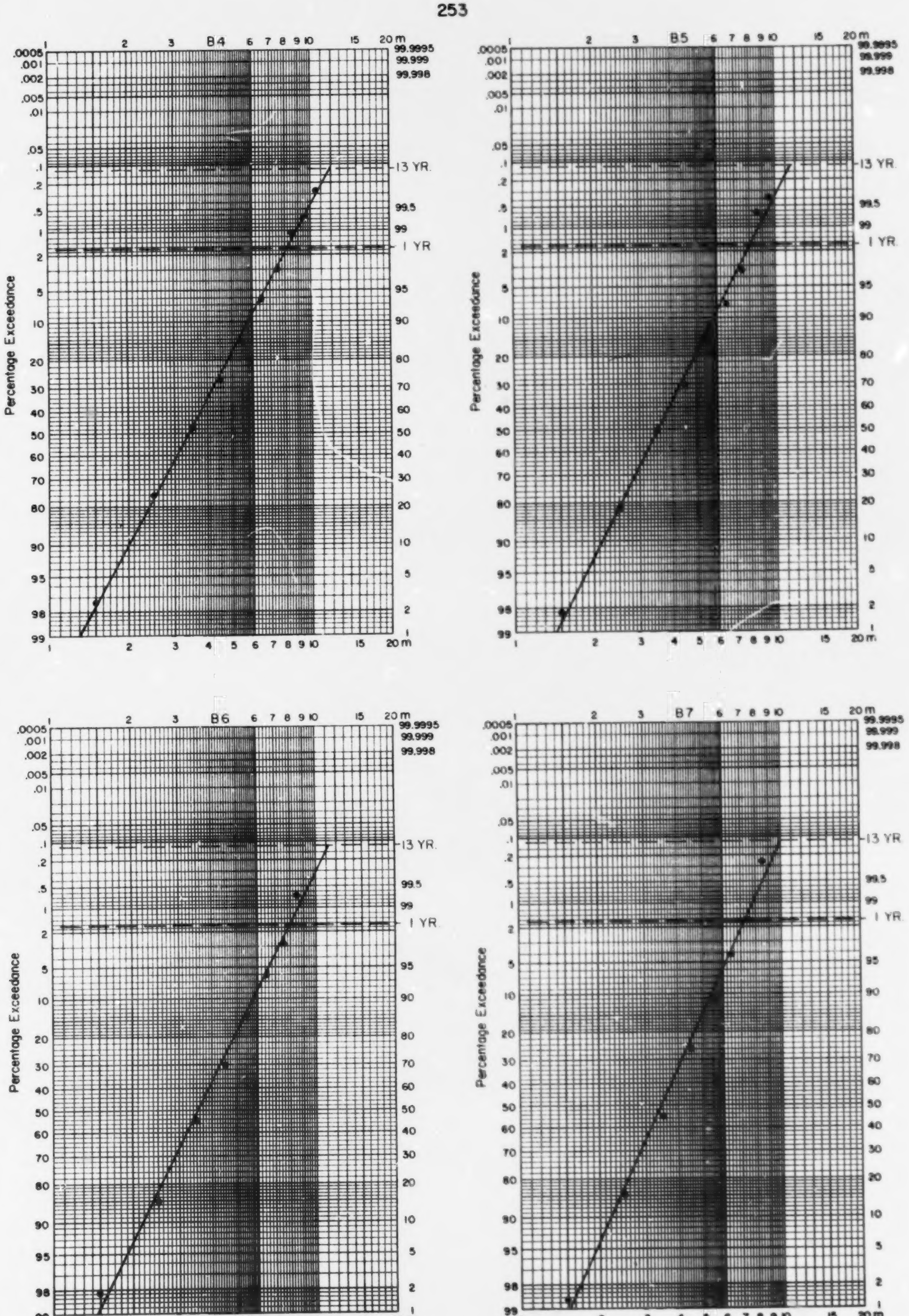


Figure 12f. Monthly Wave Height Exceedance Distribution for December

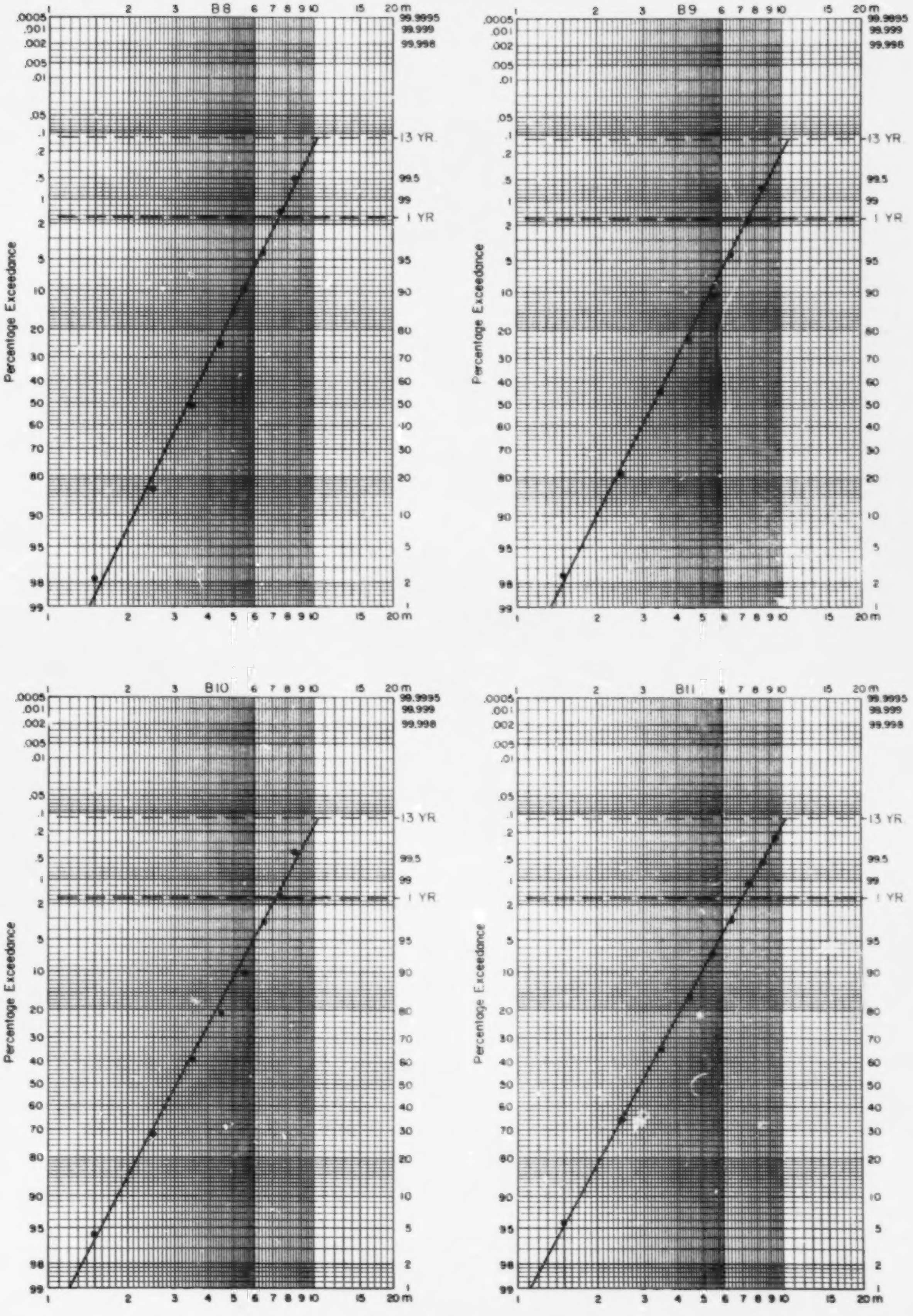


Figure 12g. Monthly Wave Height Exceedance Distribution for December

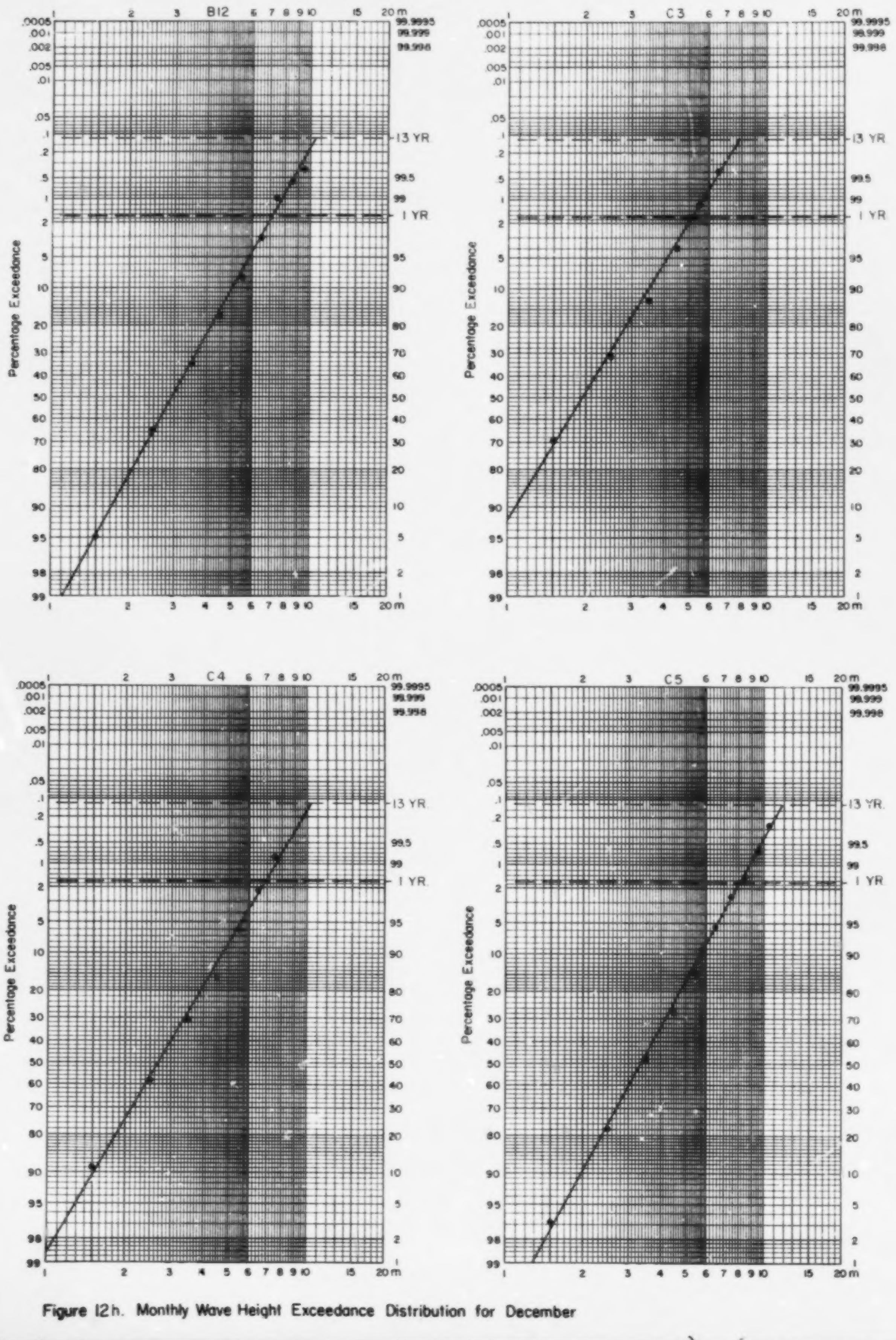


Figure 12h. Monthly Wave Height Exceedance Distribution for December

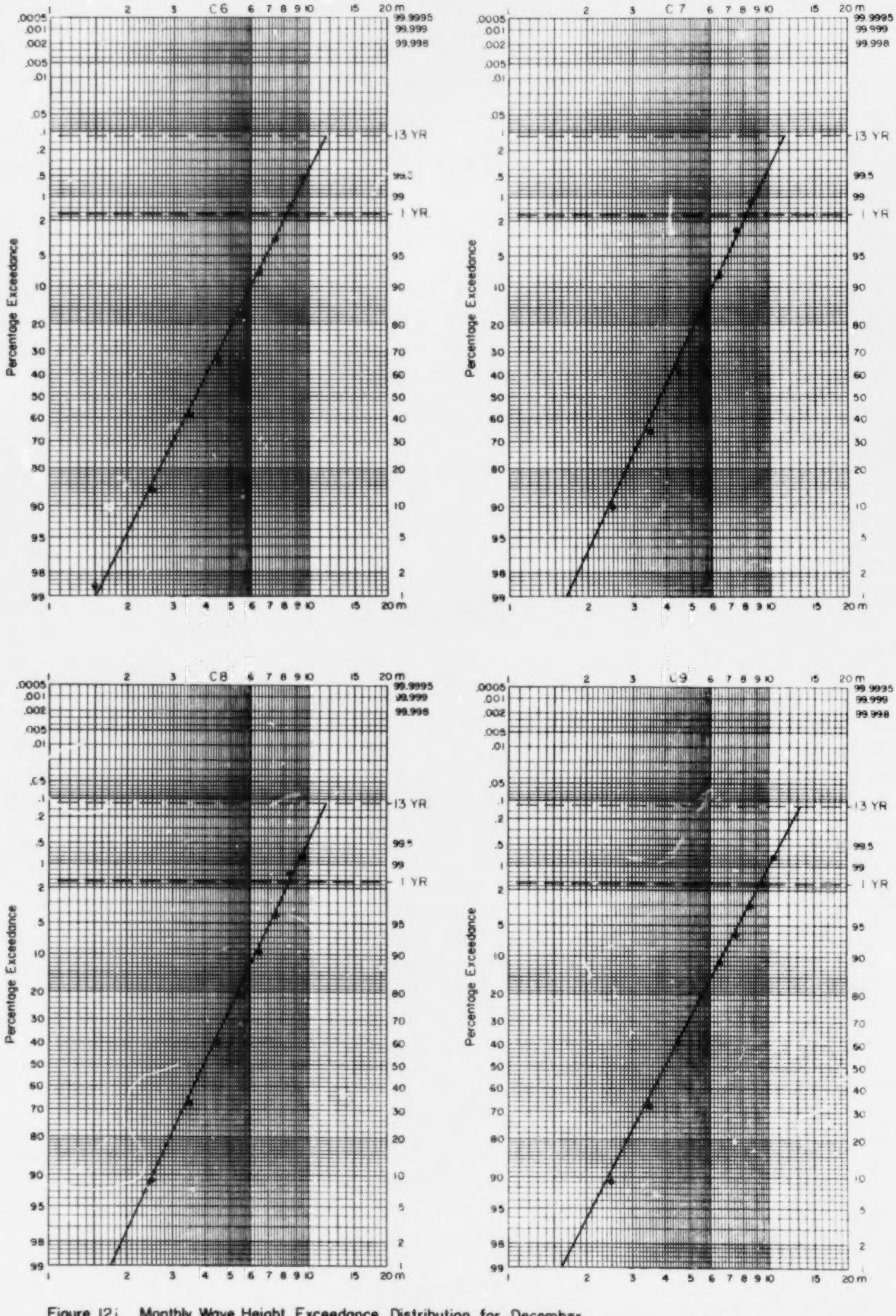


Figure 12i. Monthly Wave Height Exceedance Distribution for December

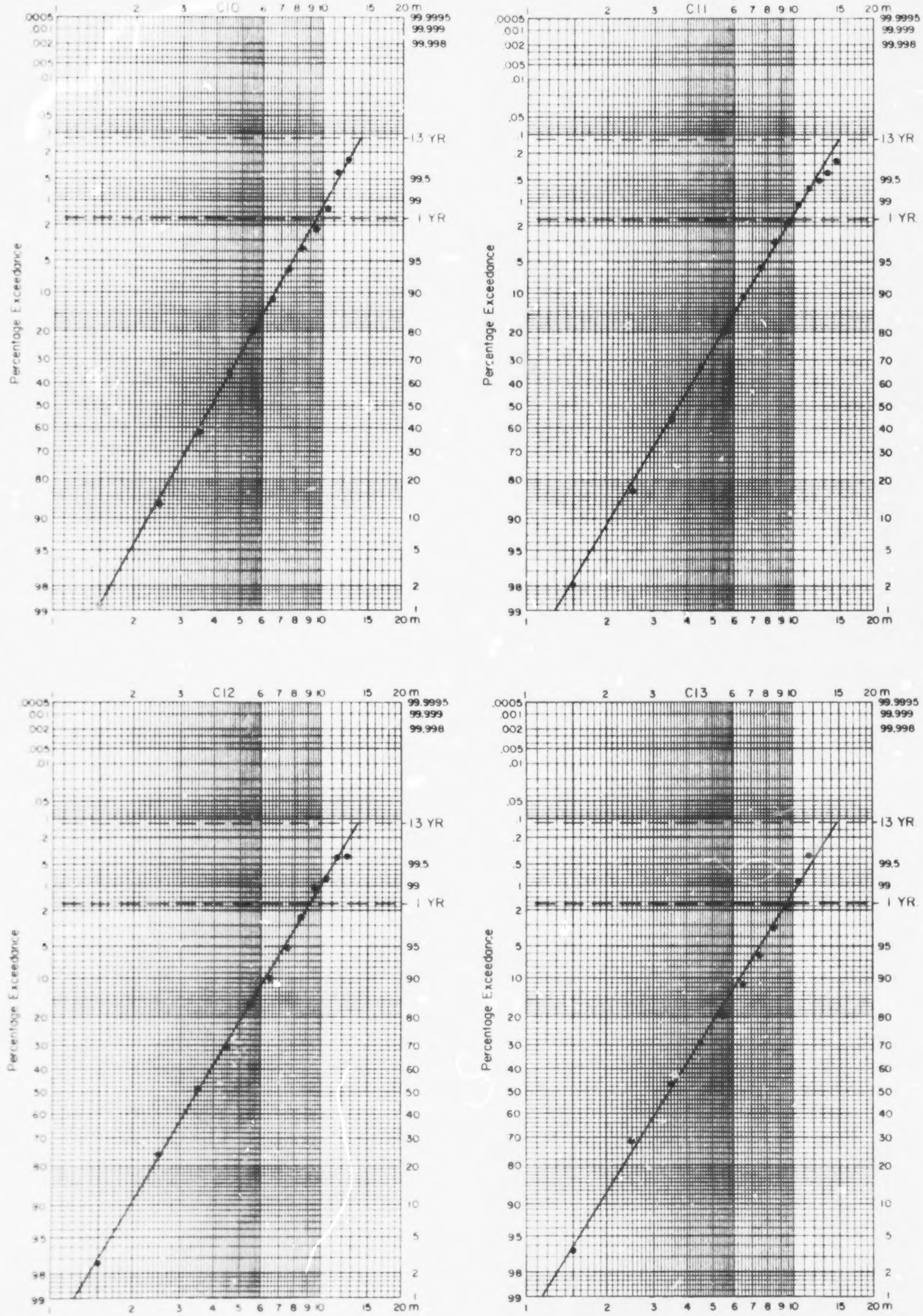


Figure 12j. Monthly Wave Height Exceedance Distribution for December

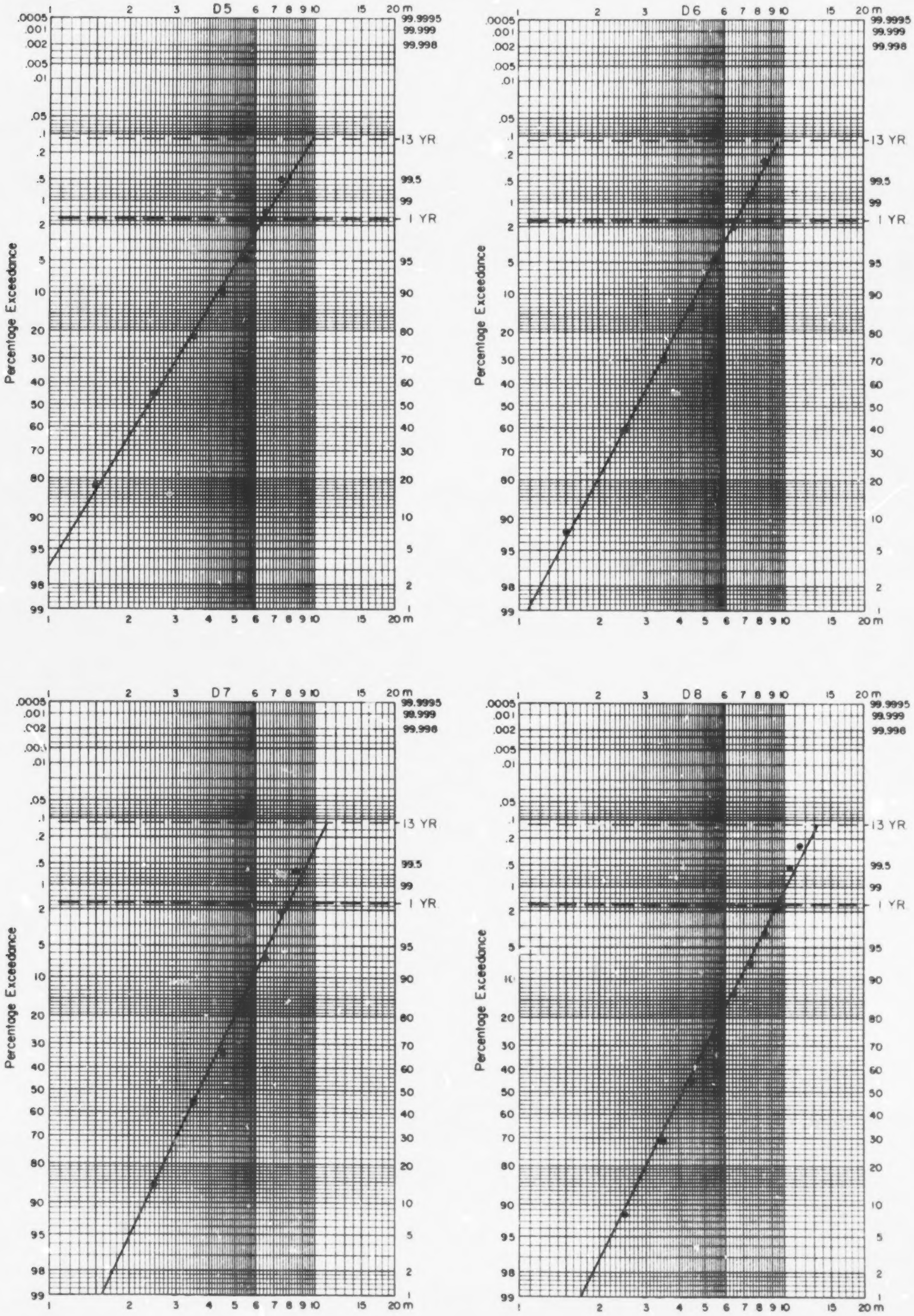
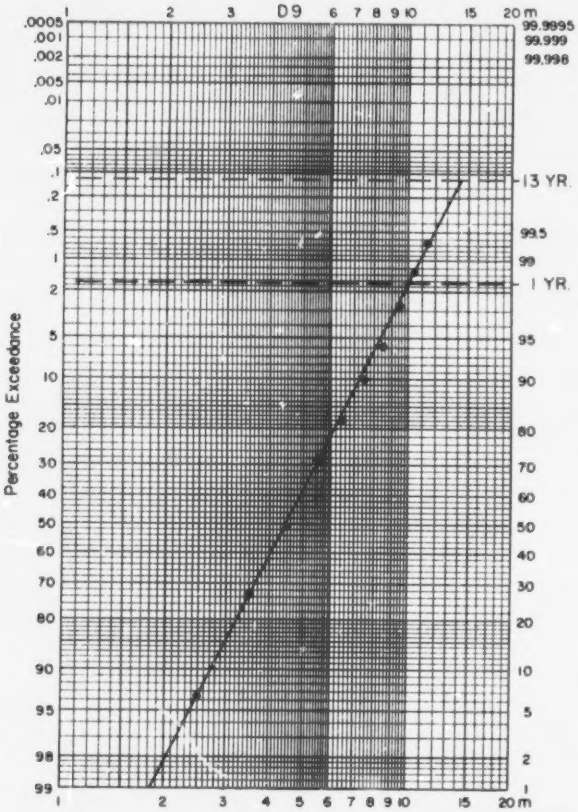
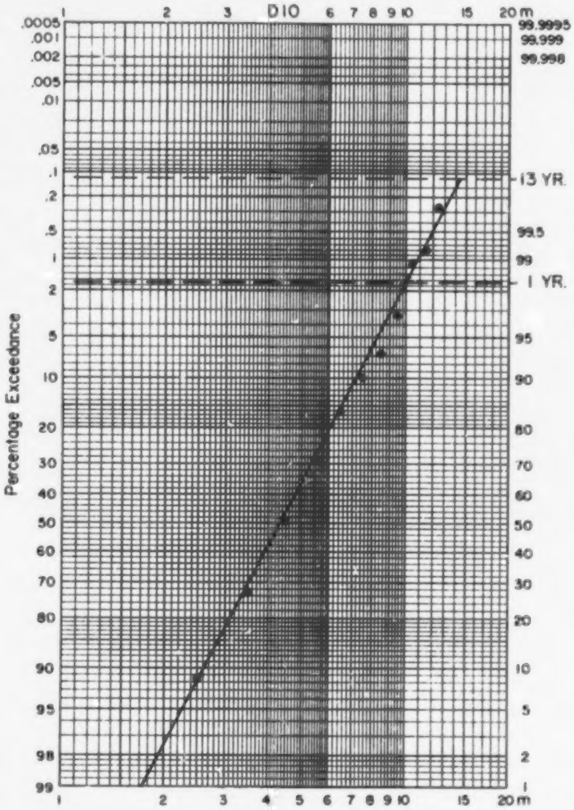
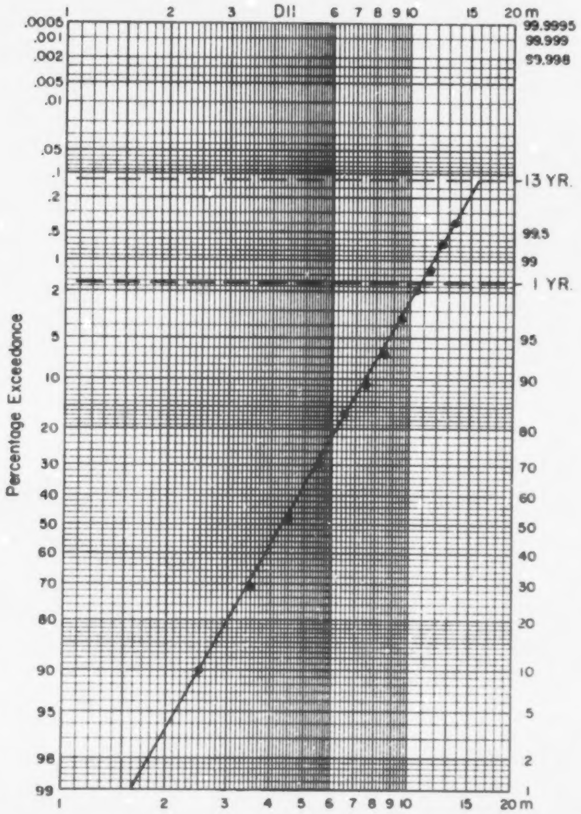


Figure 12k. Monthly Wave Height Exceedance Distribution for December







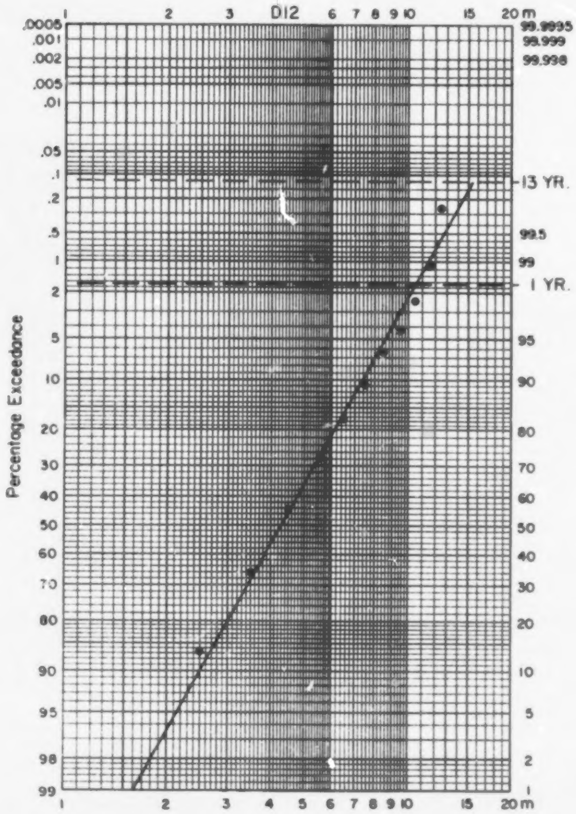


Figure 121. Monthly Wave Height Exceedance Distribution for December

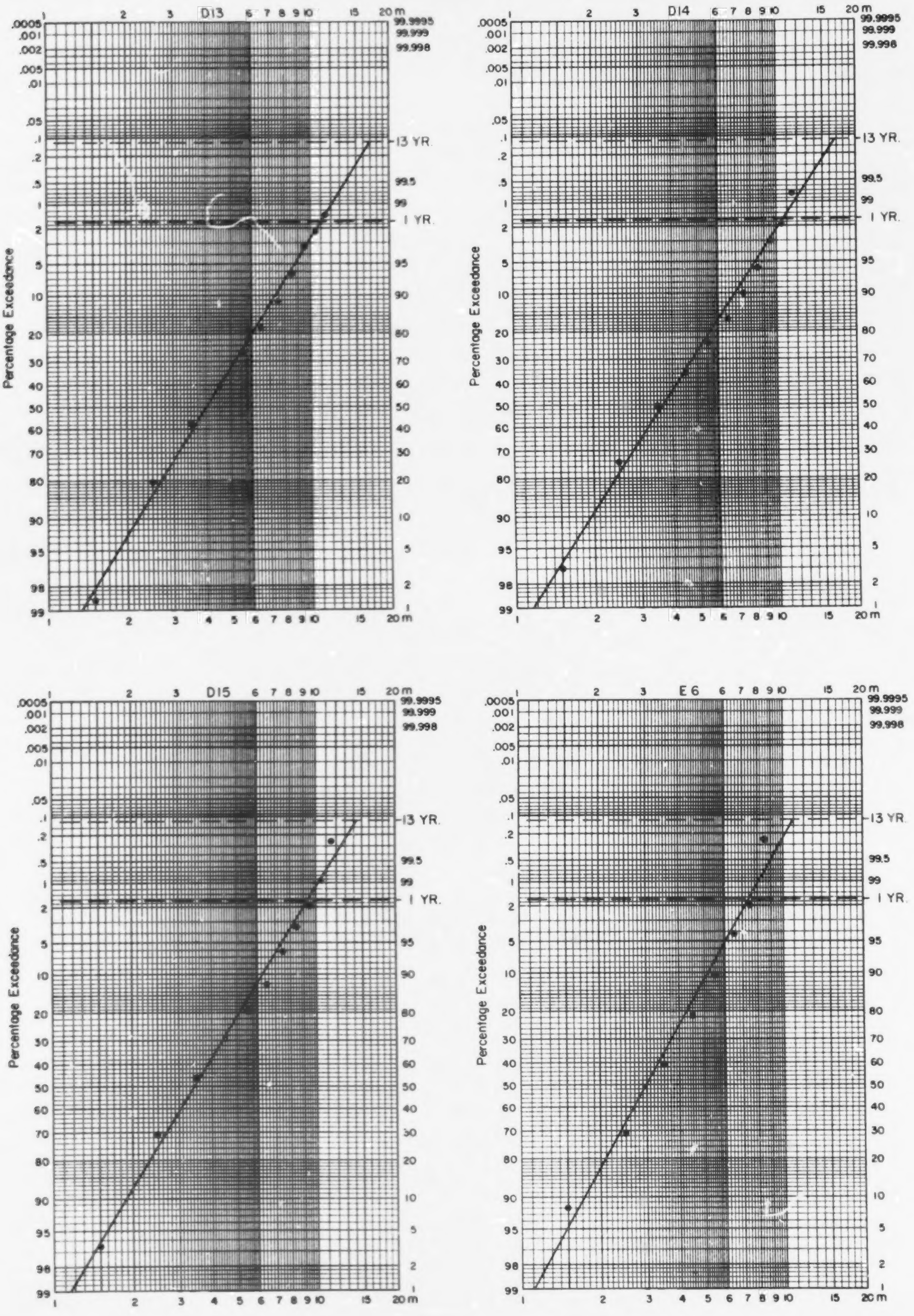


Figure 12m. Monthly Wave Height Exceedance Distribution for December

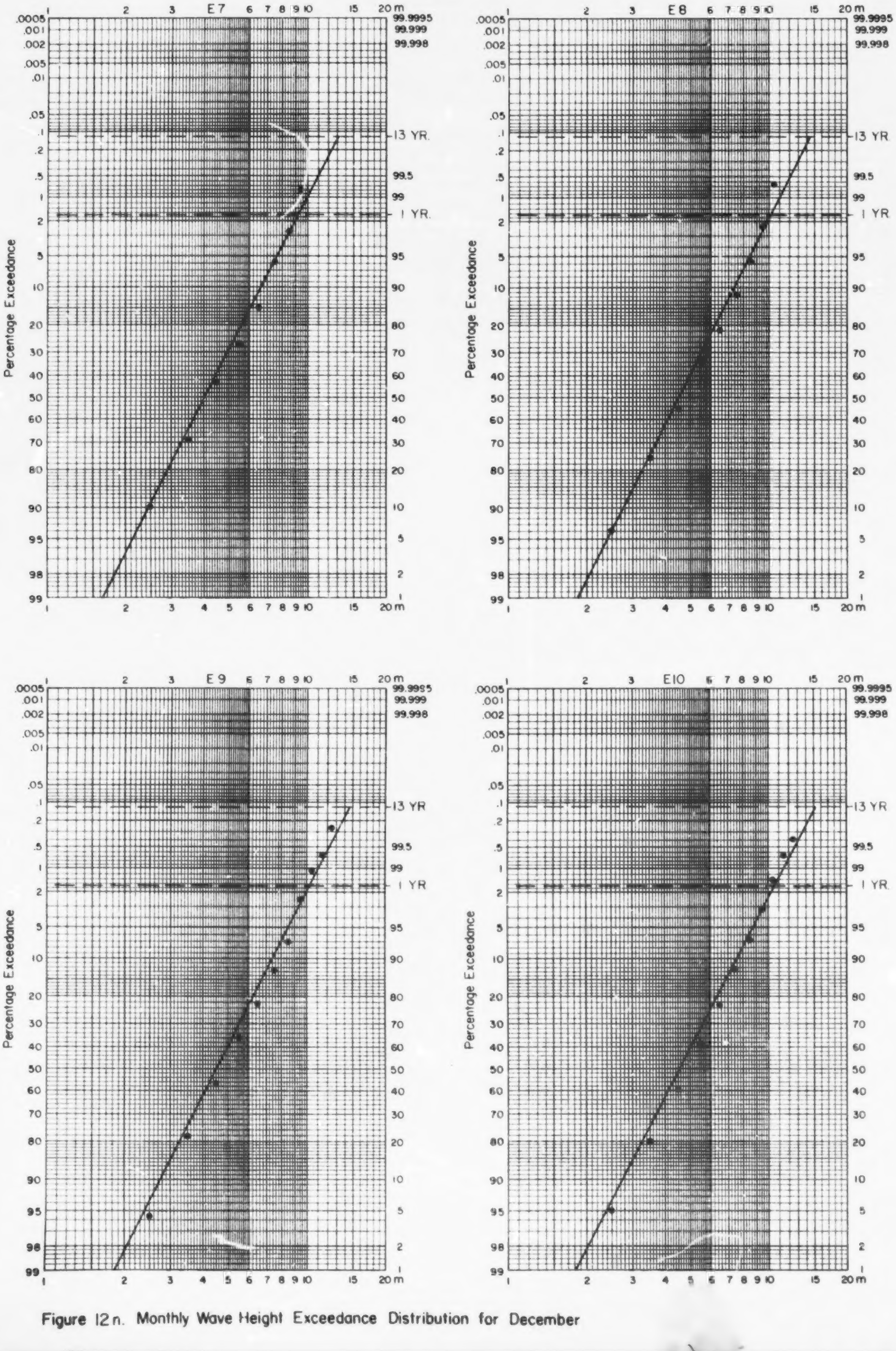


Figure 12n. Monthly Wave Height Exceedance Distribution for December

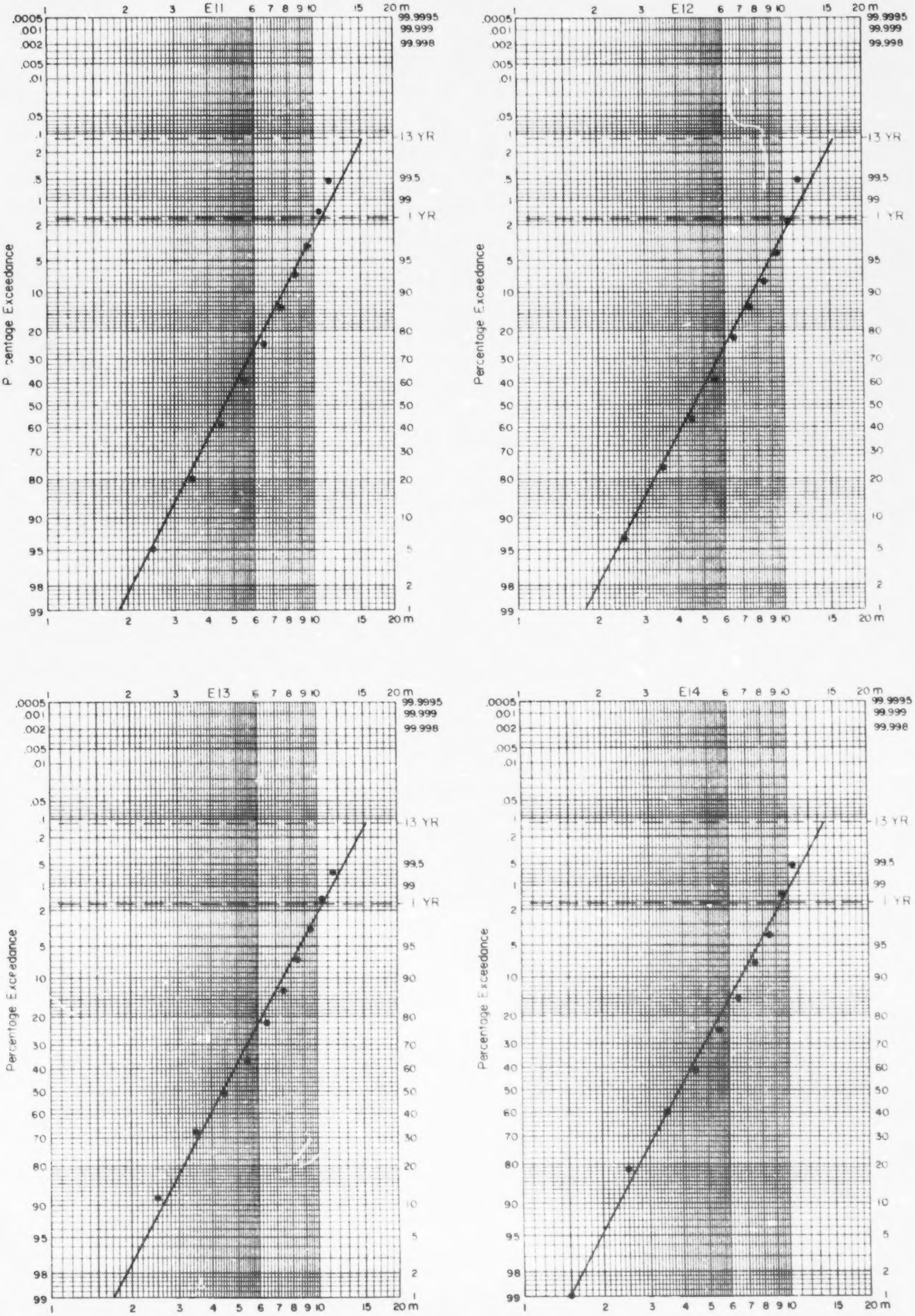


Figure 12o. Monthly Wave Height Exceedance Distribution for December

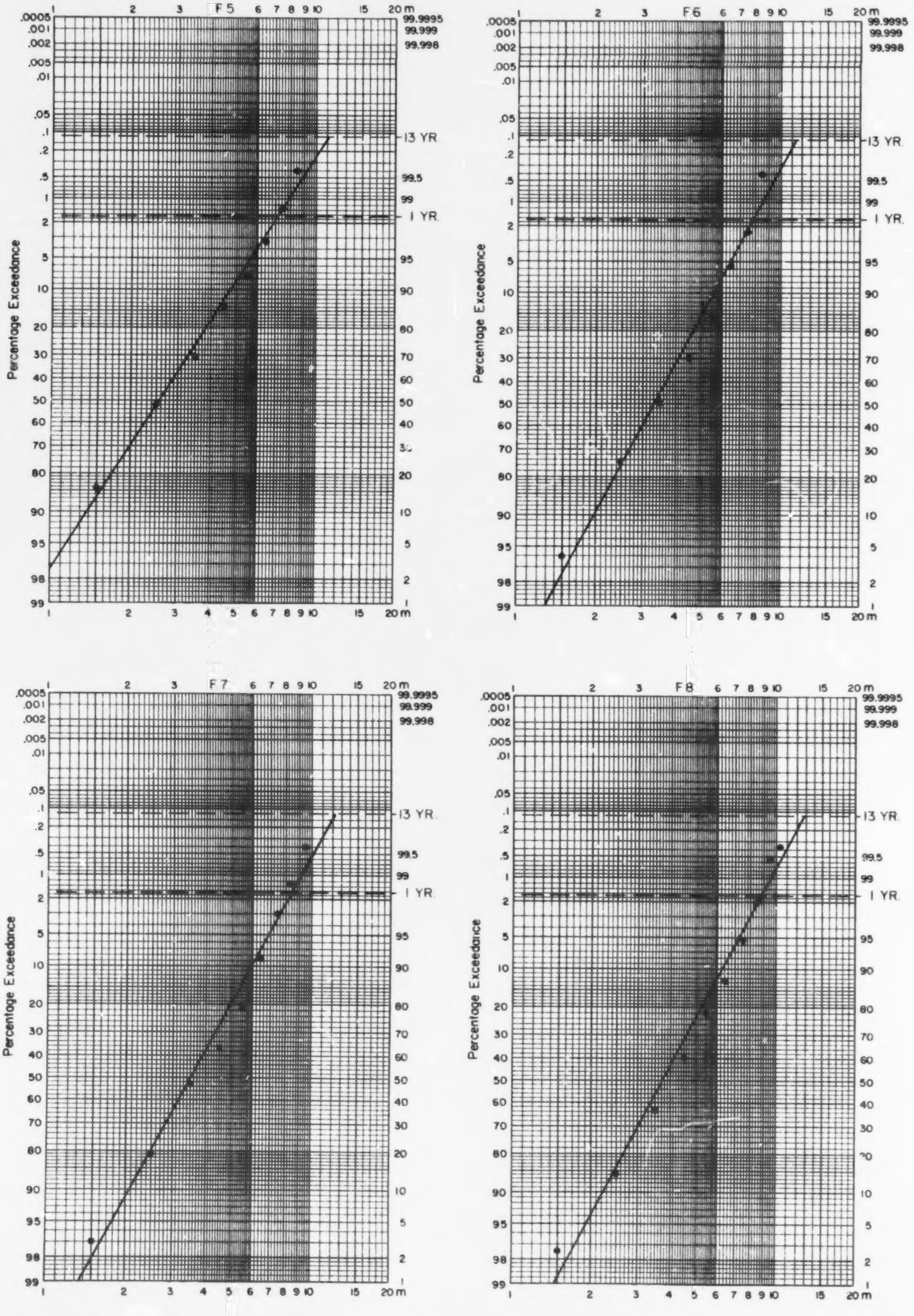


Figure 12p. Monthly Wave Height Exceedance Distribution for December

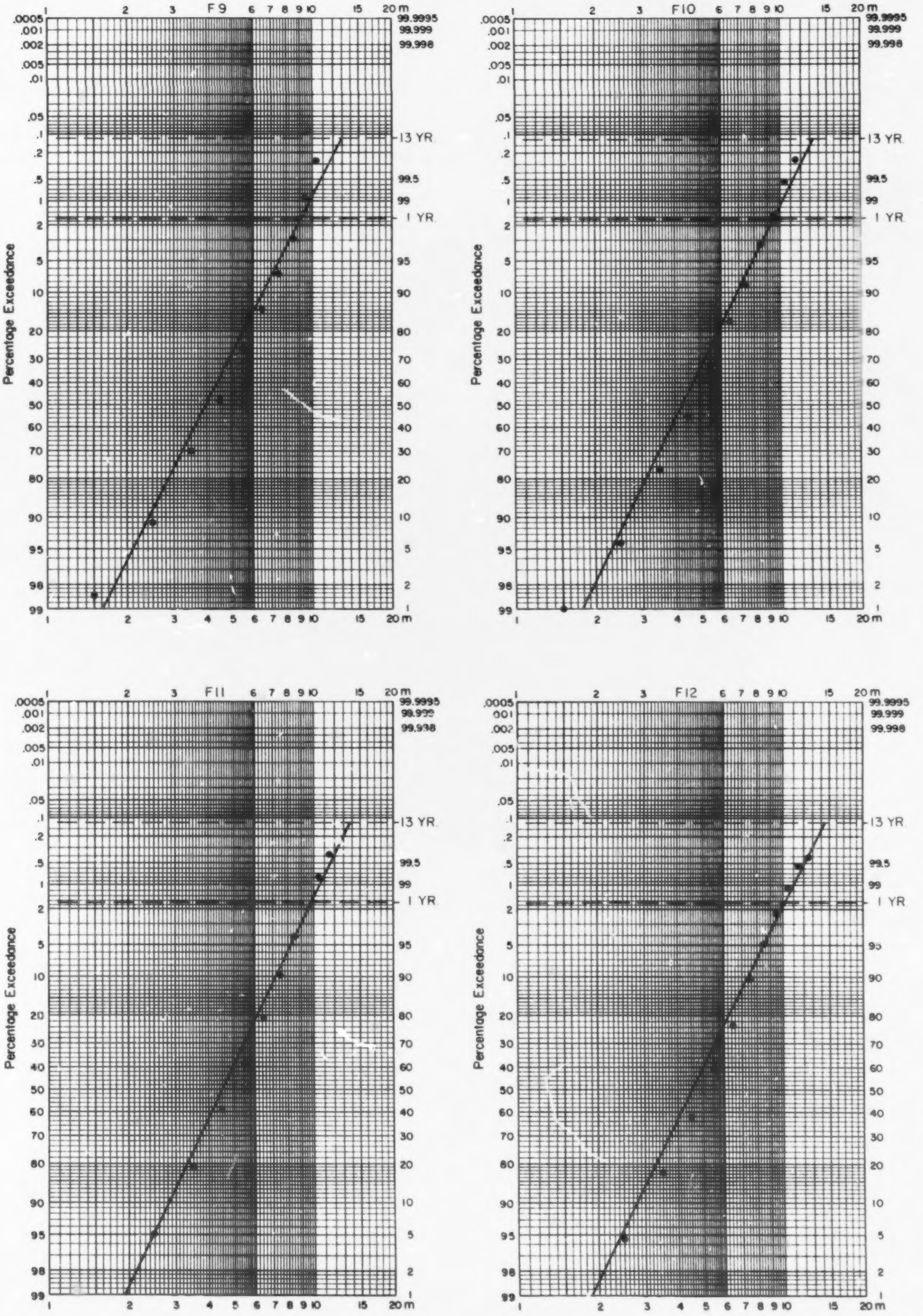


Figure 12q. Monthly Wave Height Exceedance Distribution for December

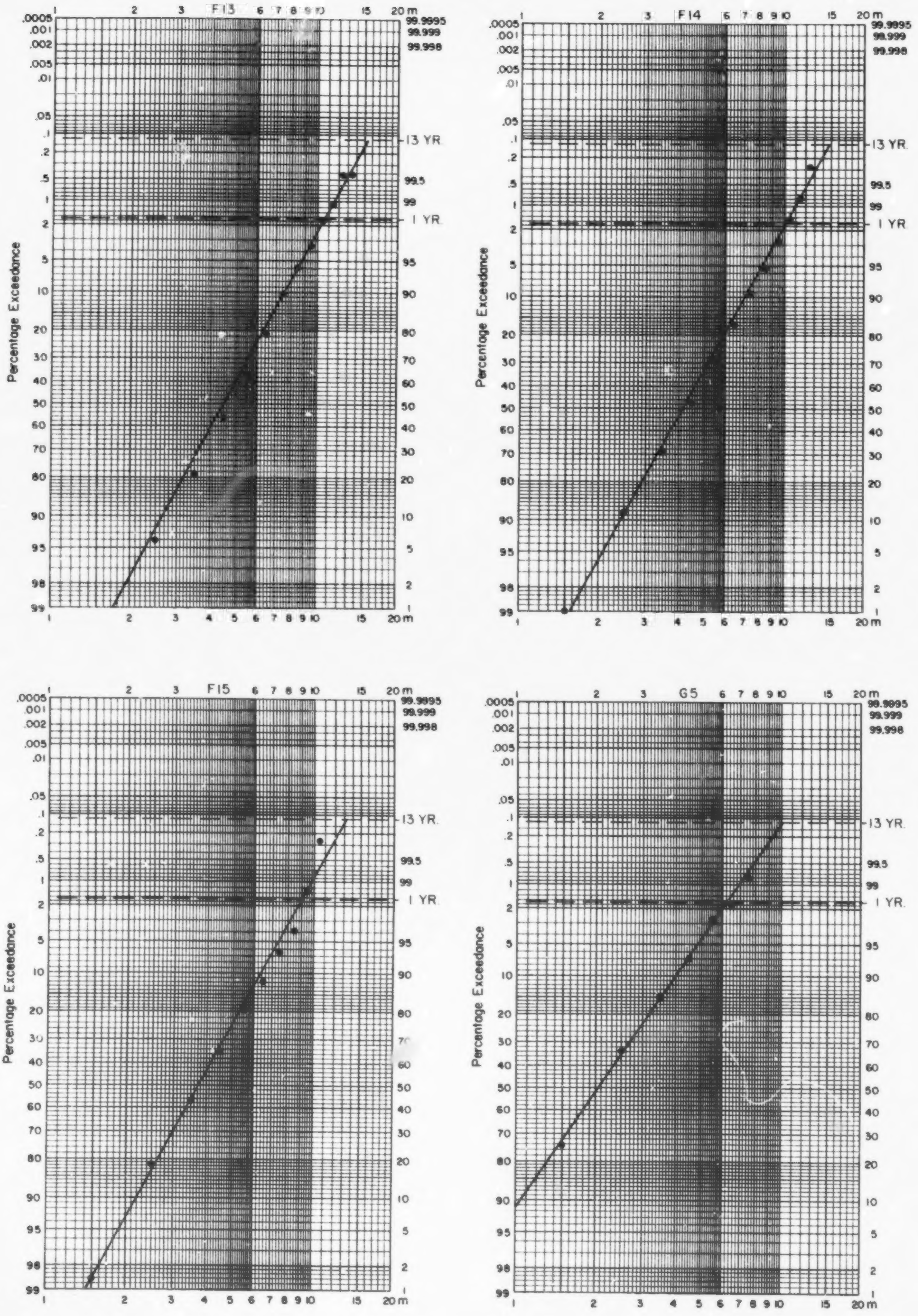


Figure 12 r. Monthly Wave Height Exceedance Distribution for December

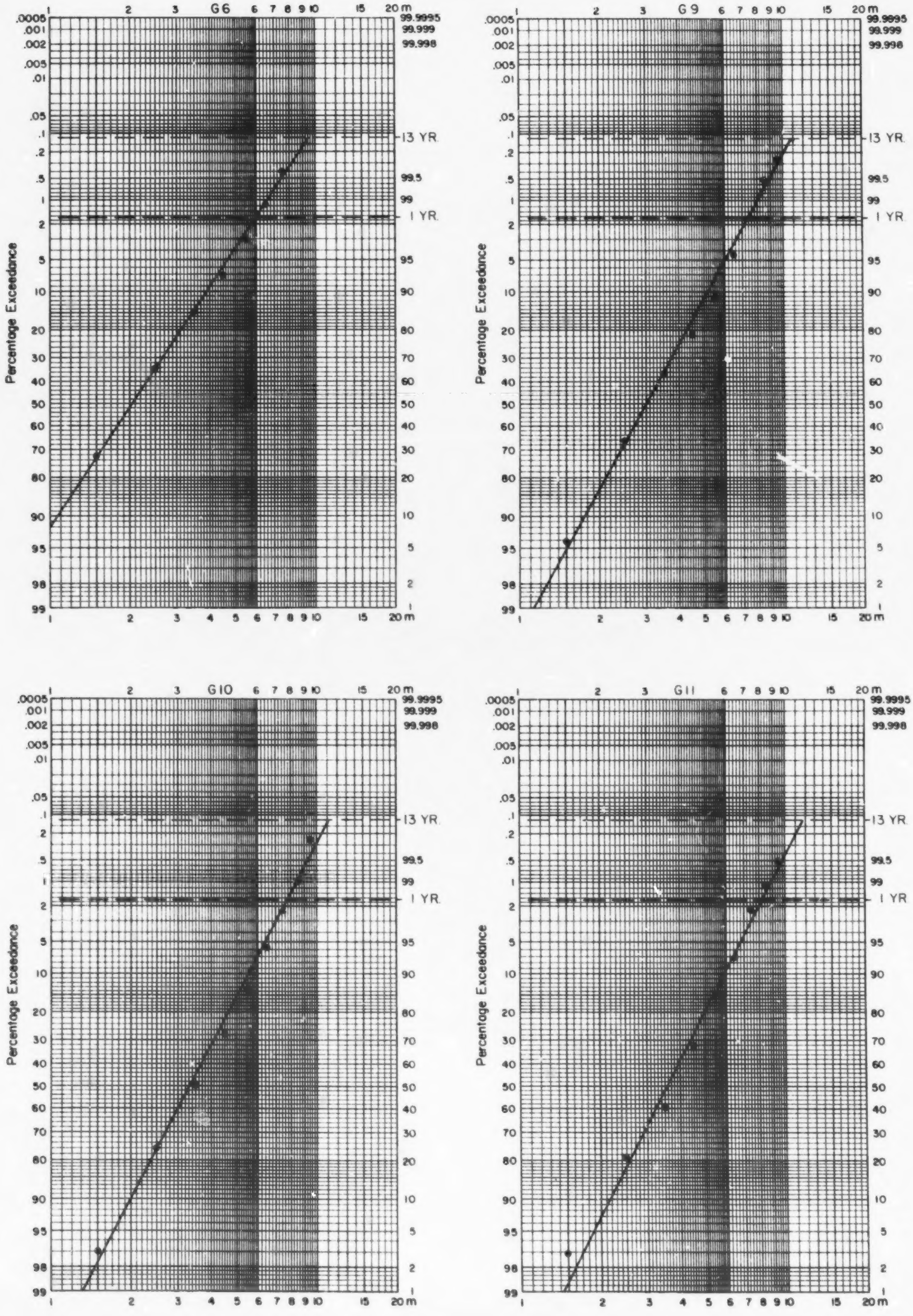


Figure 12 s. Monthly Wave Height Exceedance Distribution for December

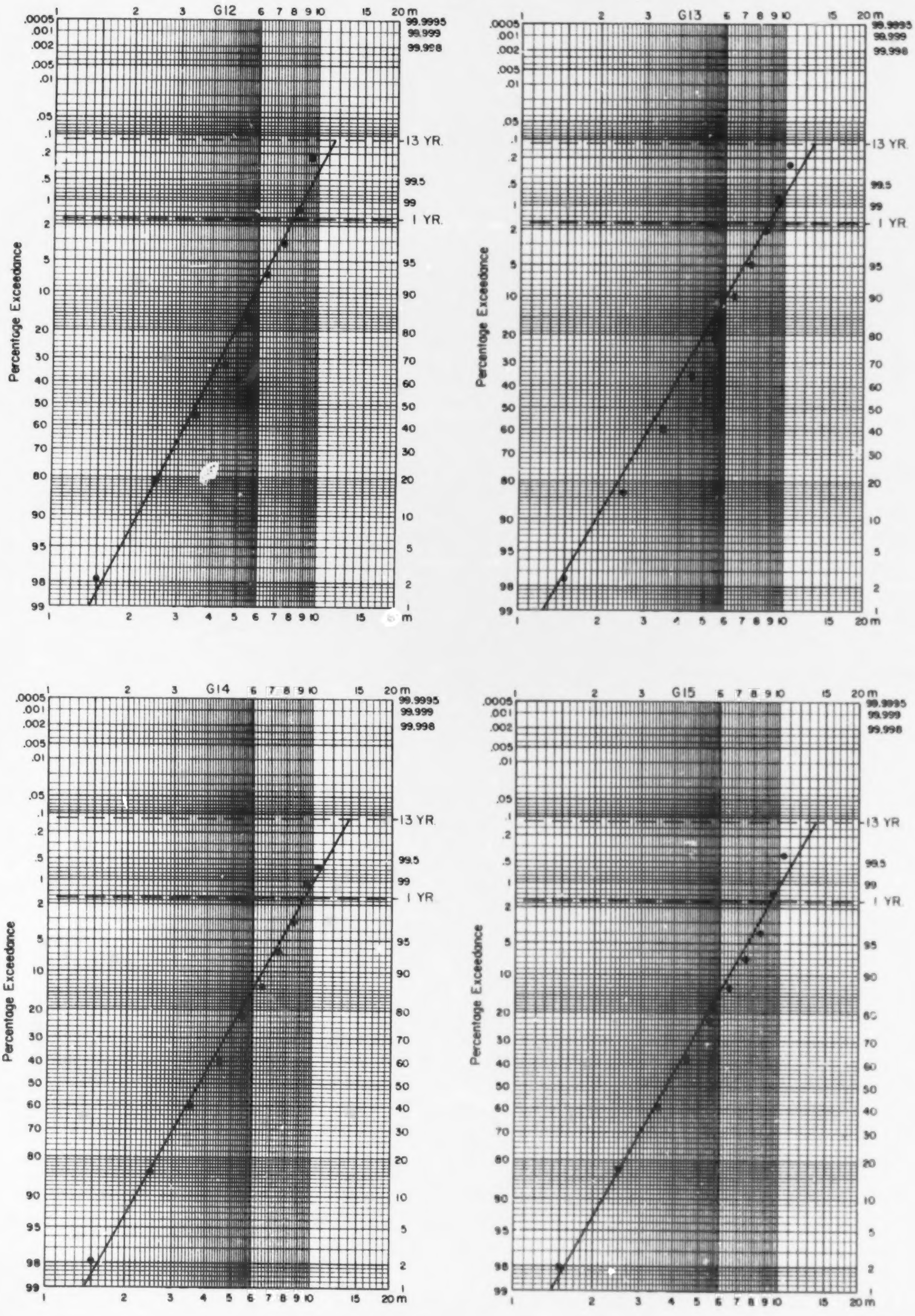


Figure 121. Monthly Wave Height Exceedance Distribution for December

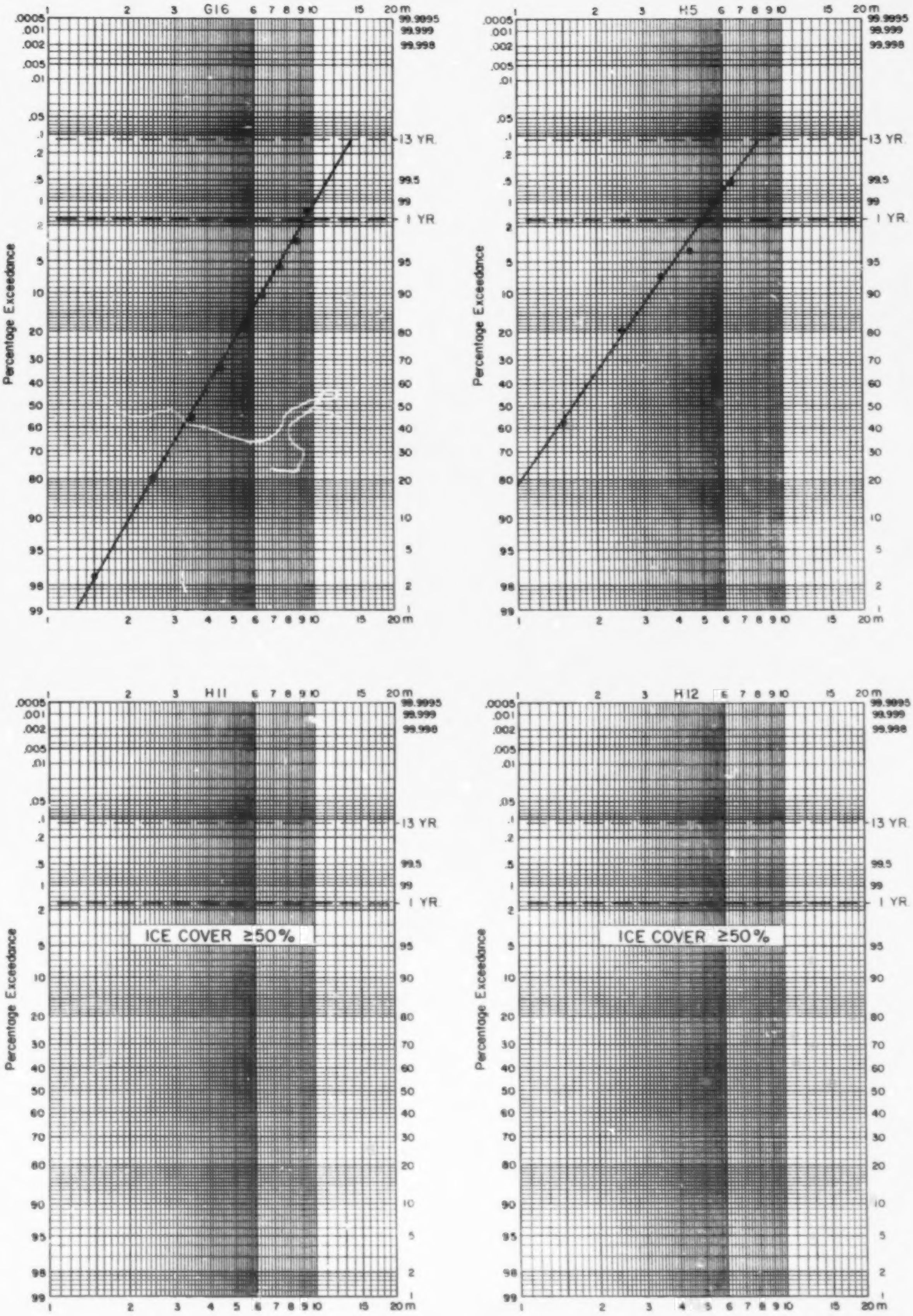


Figure 12u. Monthly Wave Height Exceedance Distribution for December

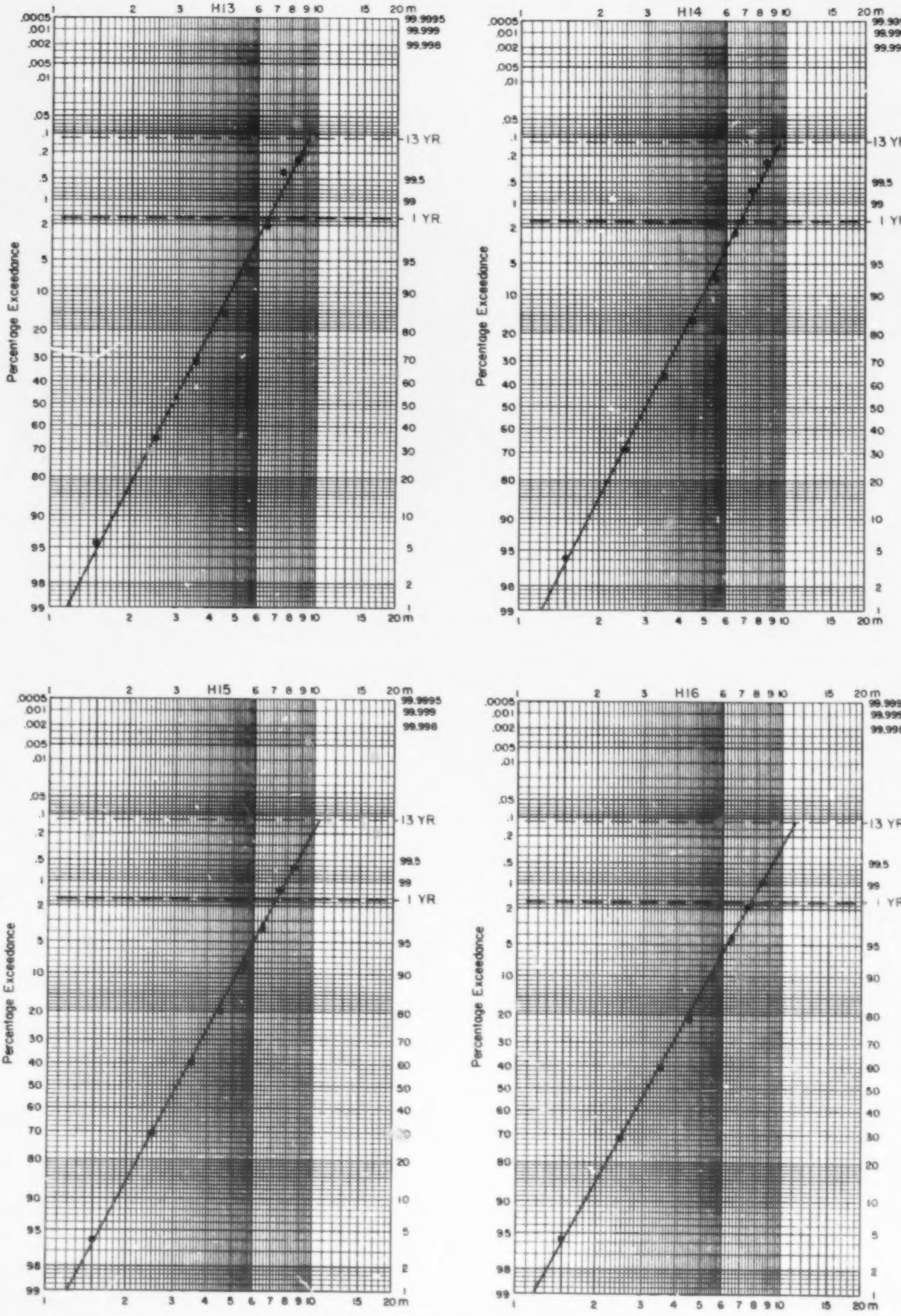


Figure 12v. Monthly Wave Height Exceedance Distribution for December

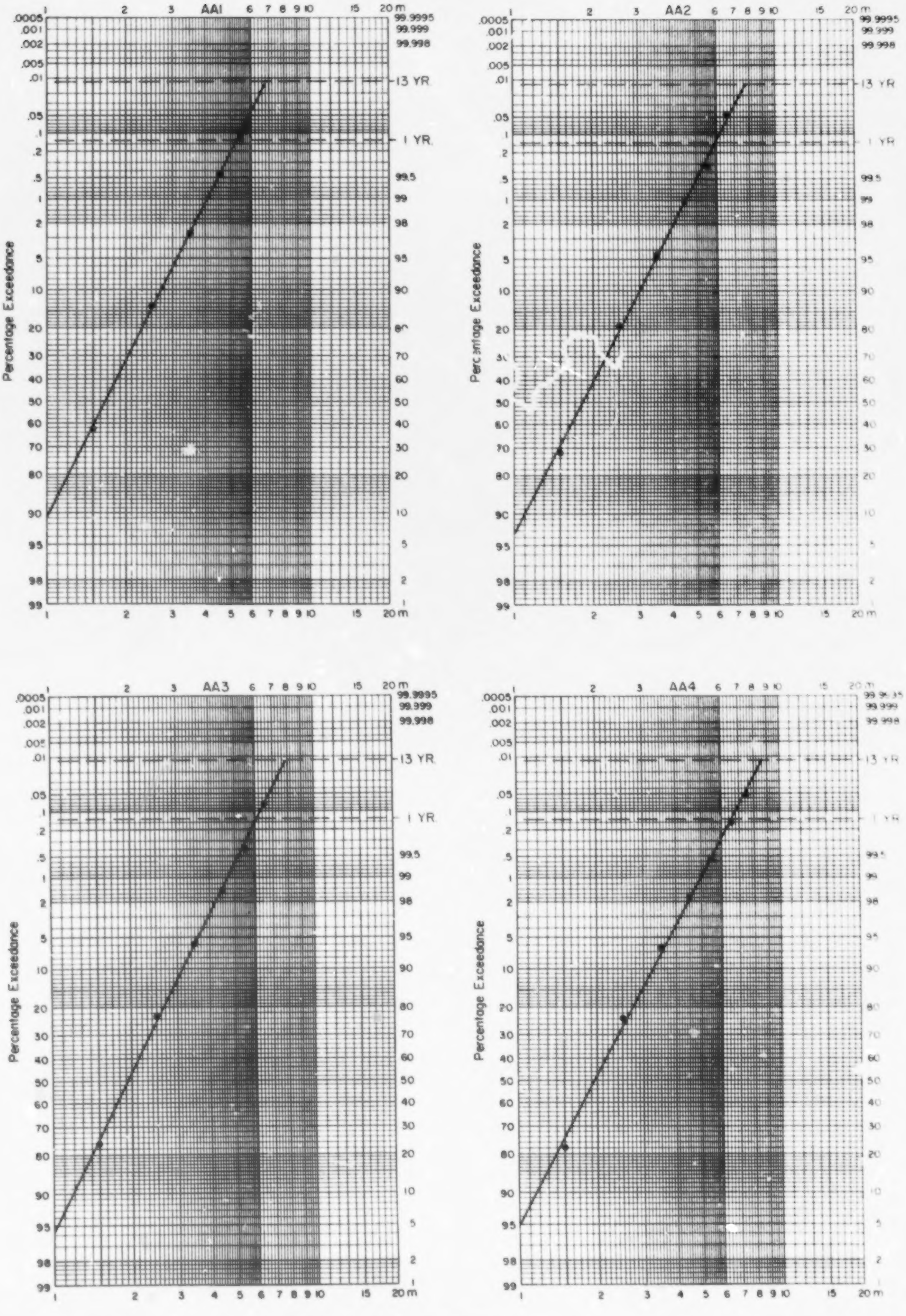


Figure 13a. 13 Years Wave Height Exceedance Distribution

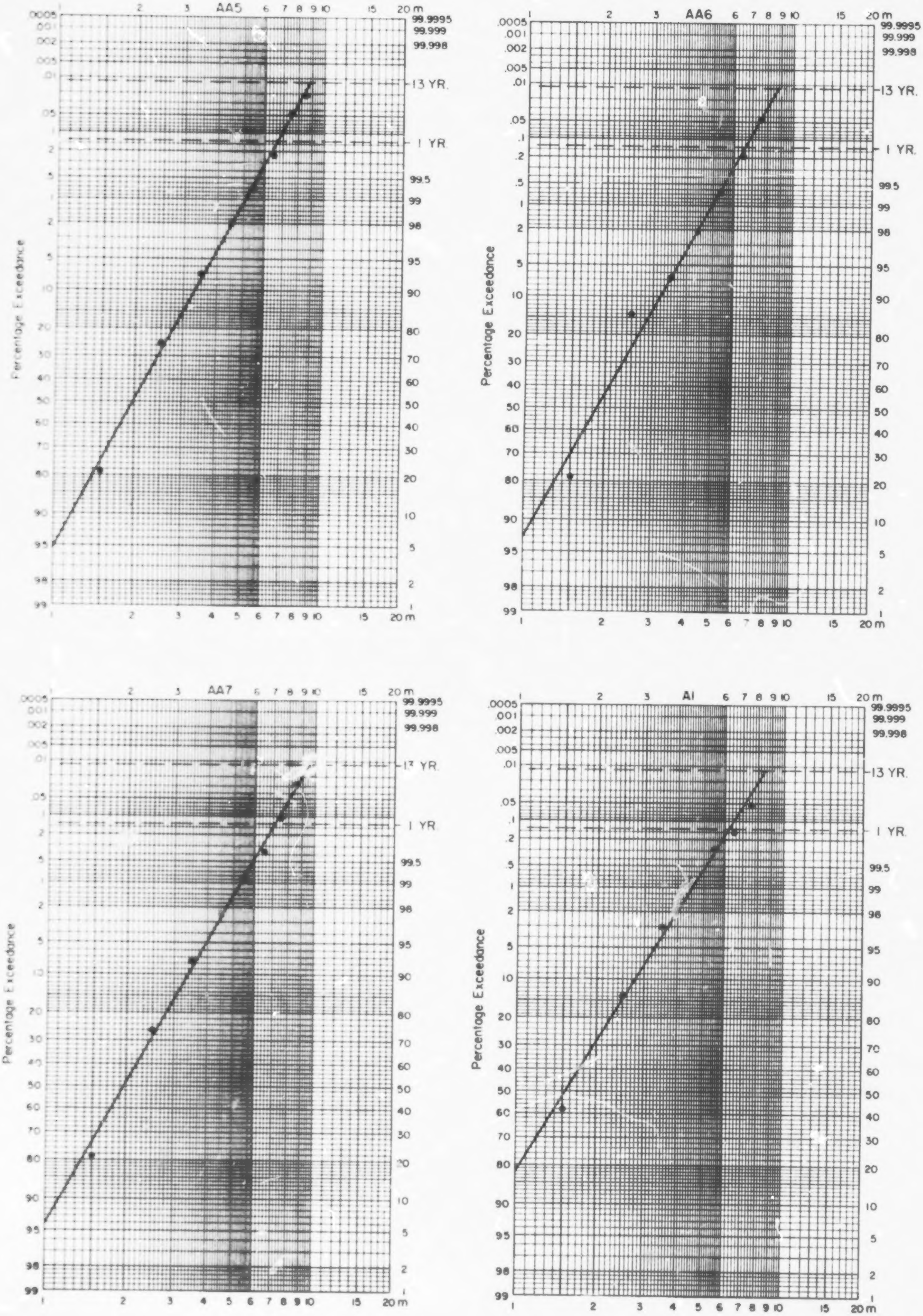


Figure 13b. 13 Years Wave Height Exceedance Distribution

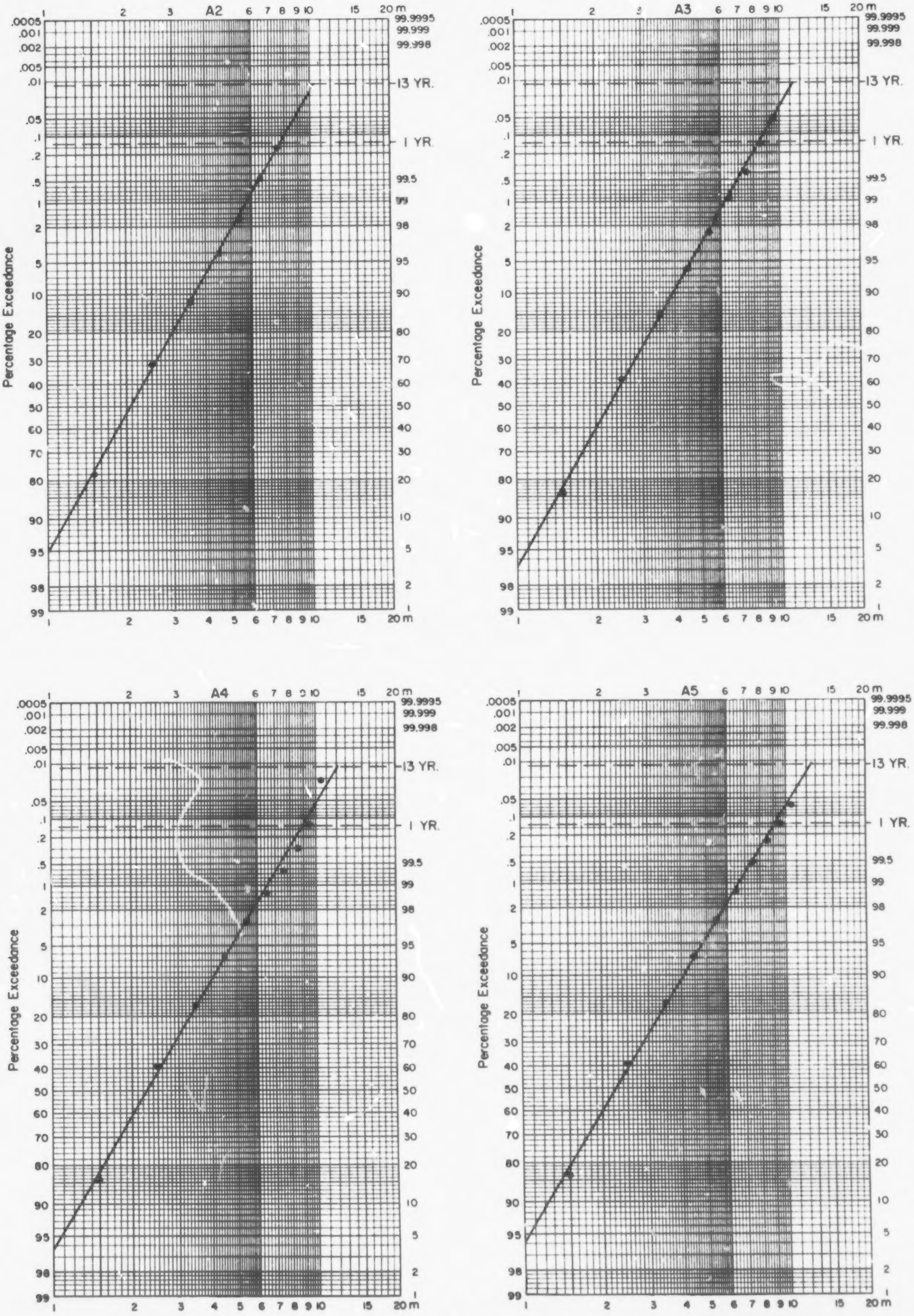


Figure 13c. 13 Years Wave Height Exceedance Distribution

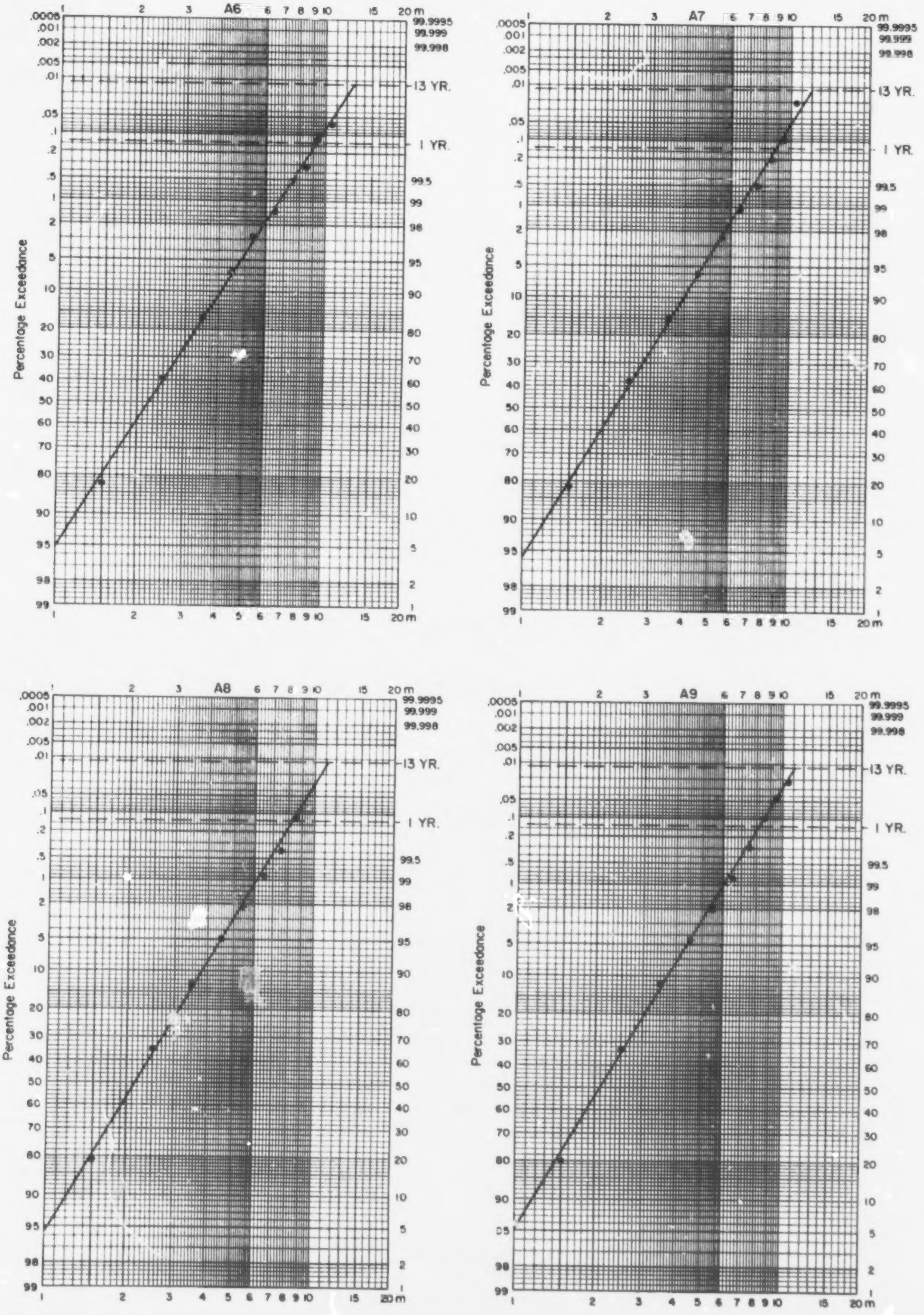


Figure 13d. 13 Years Wave Height Exceedance Distribution

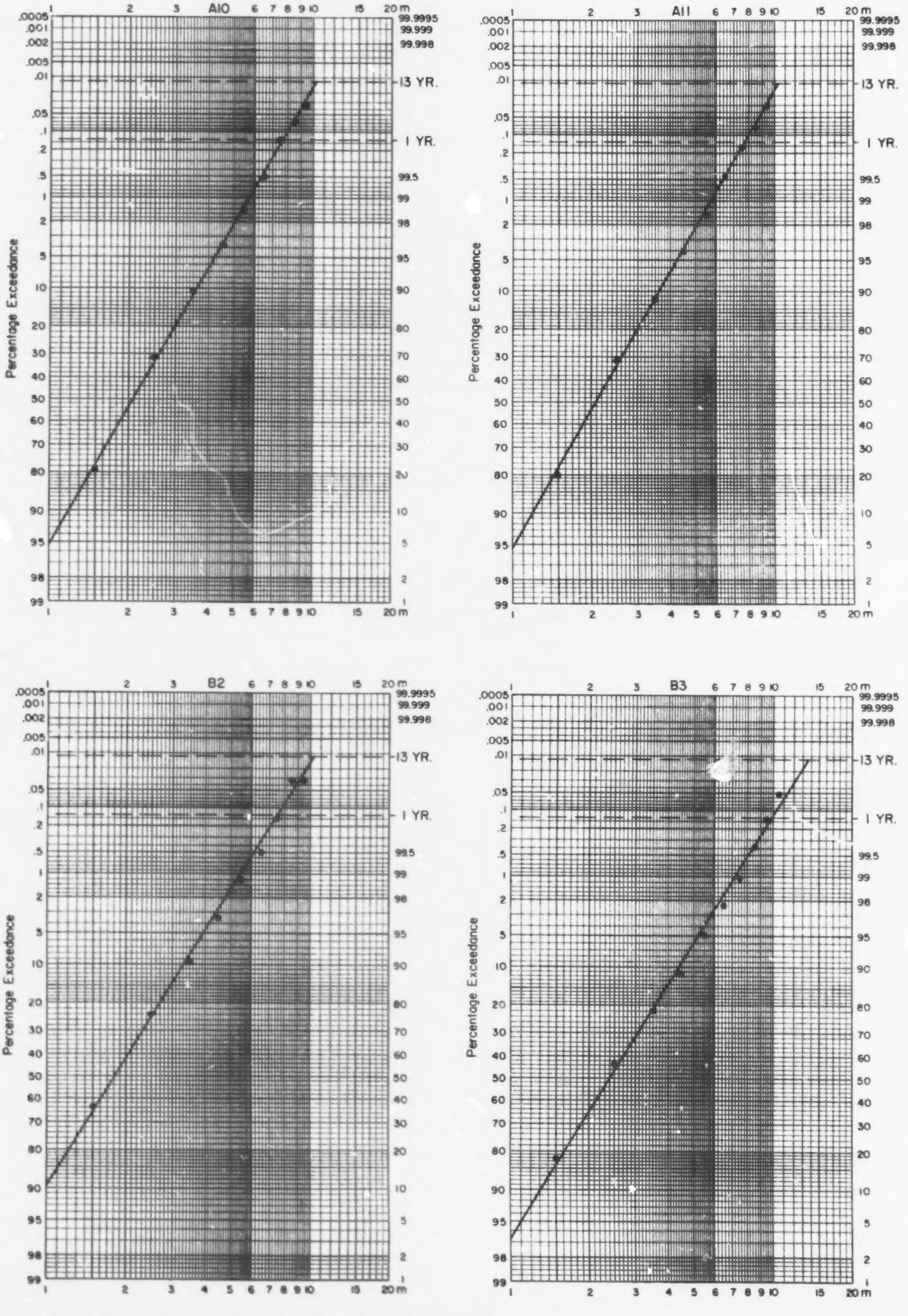


Figure 13e. 13 Years Wave Height Exceedance Distribution

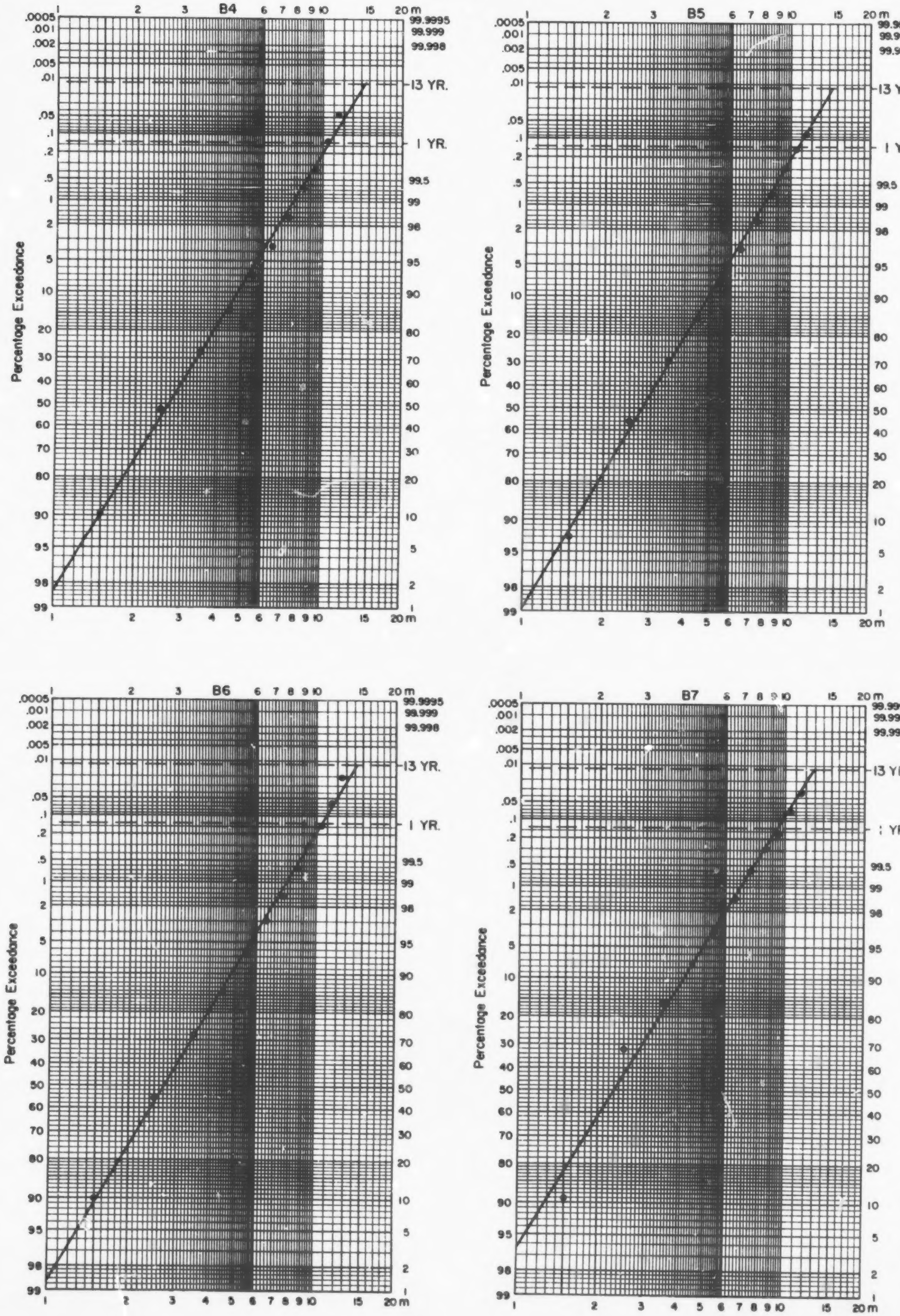


Figure 13f. 13 Years Wave Height Exceedance Distribution

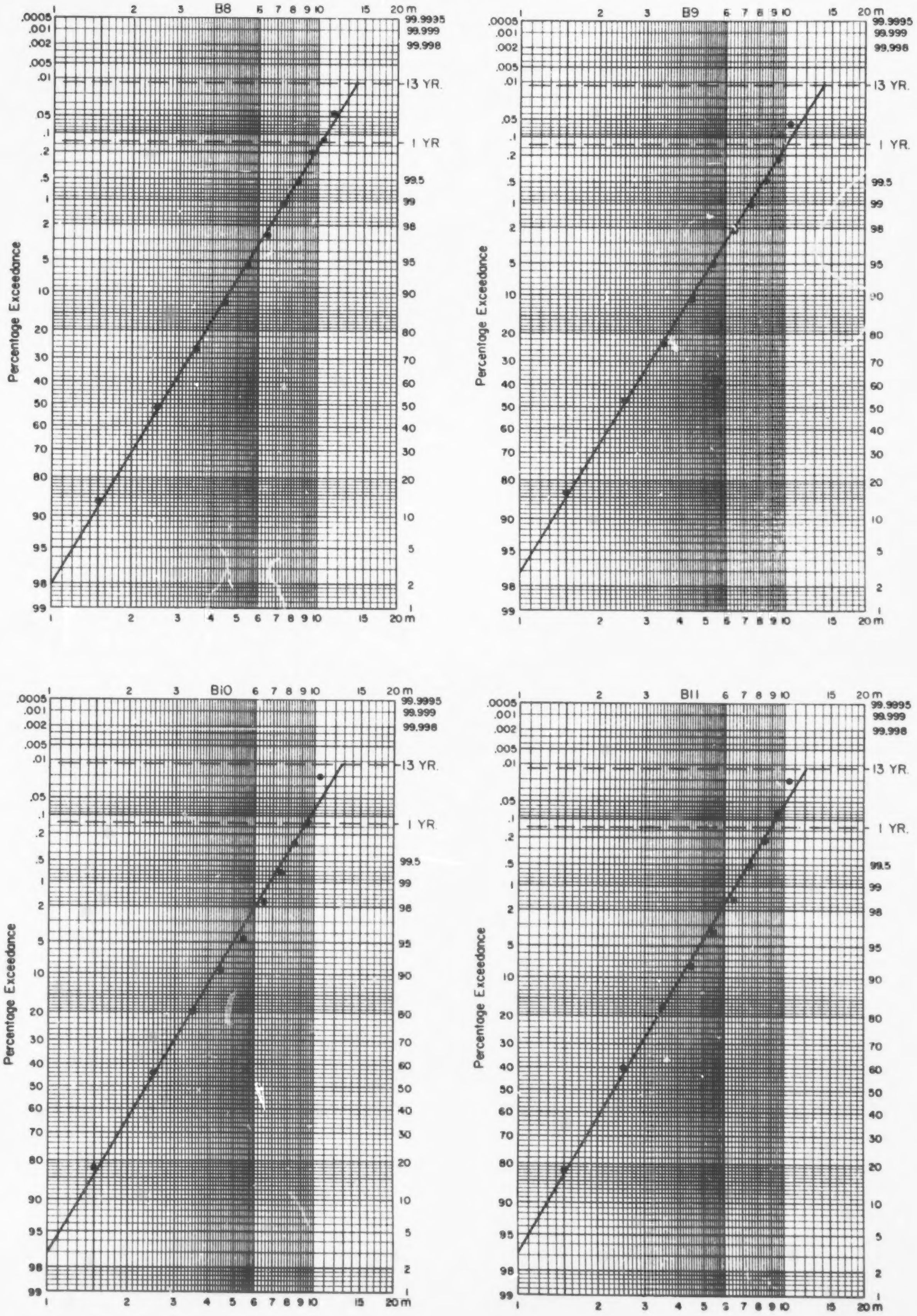


Figure 13g. 13 Years Wave Height Exceedance Distribution

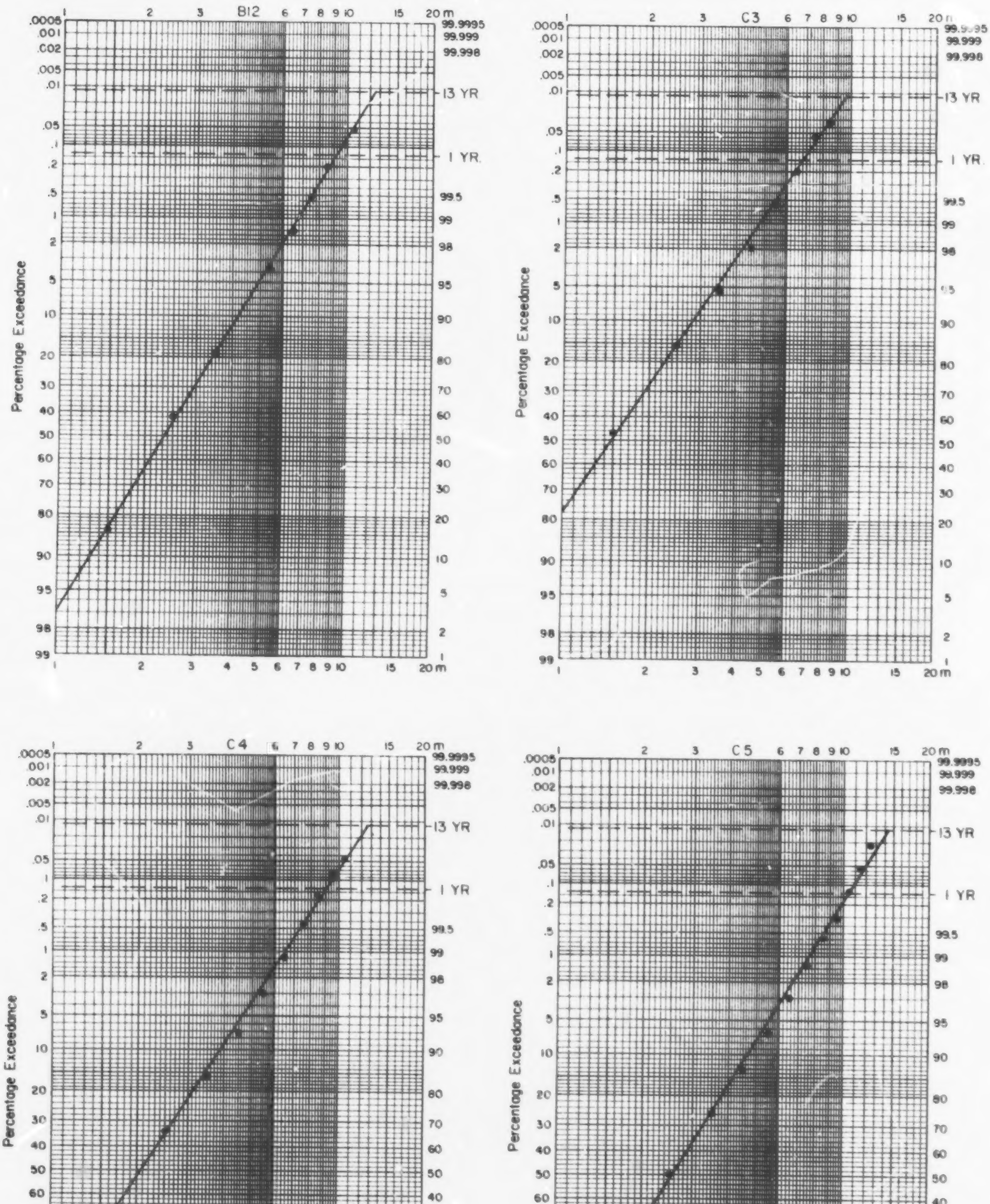


Figure 13h. 13 Years Wave Height Exceedance Distribution

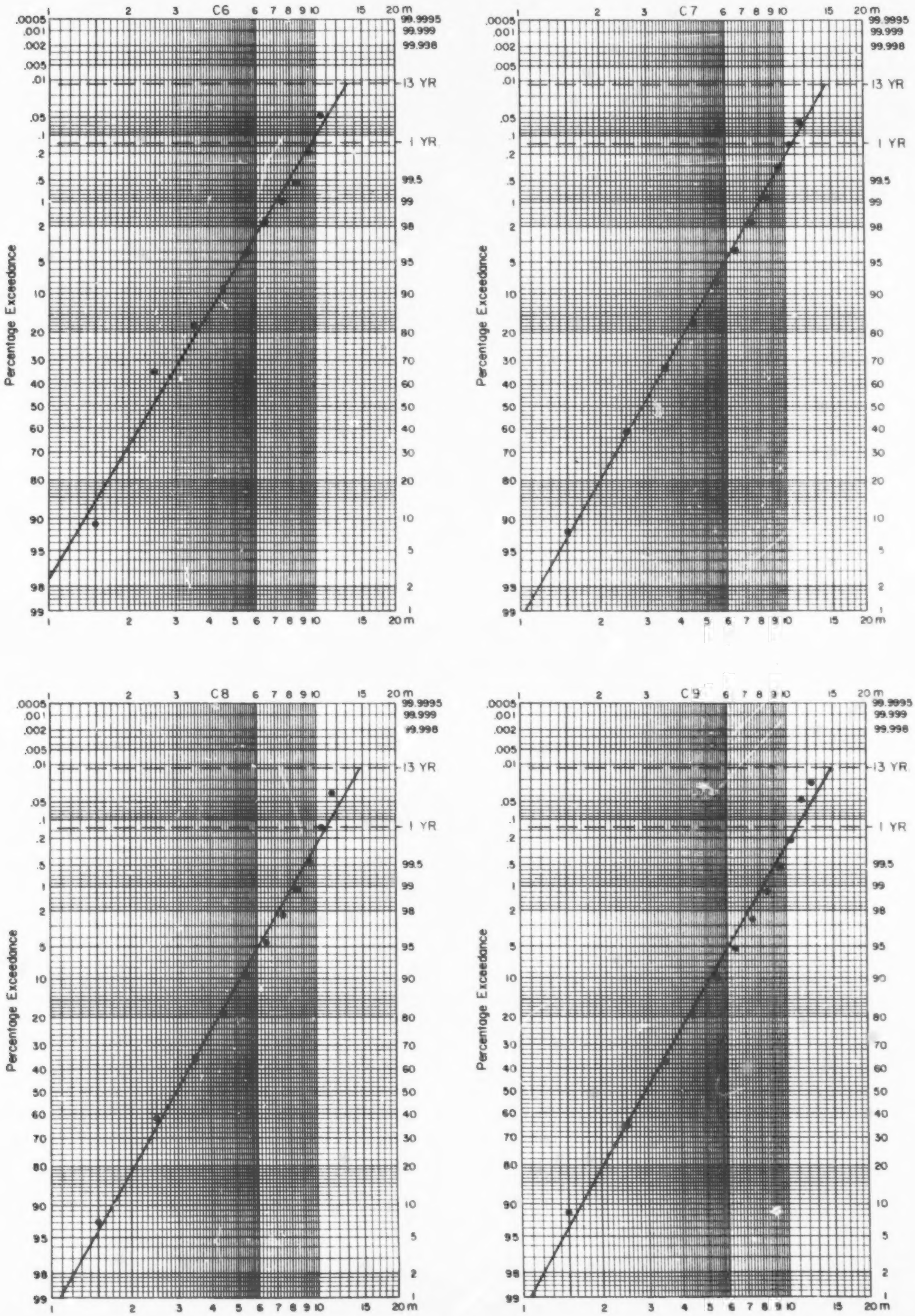


Figure 13i. 13 Years Wave Height Exceedance Distribution

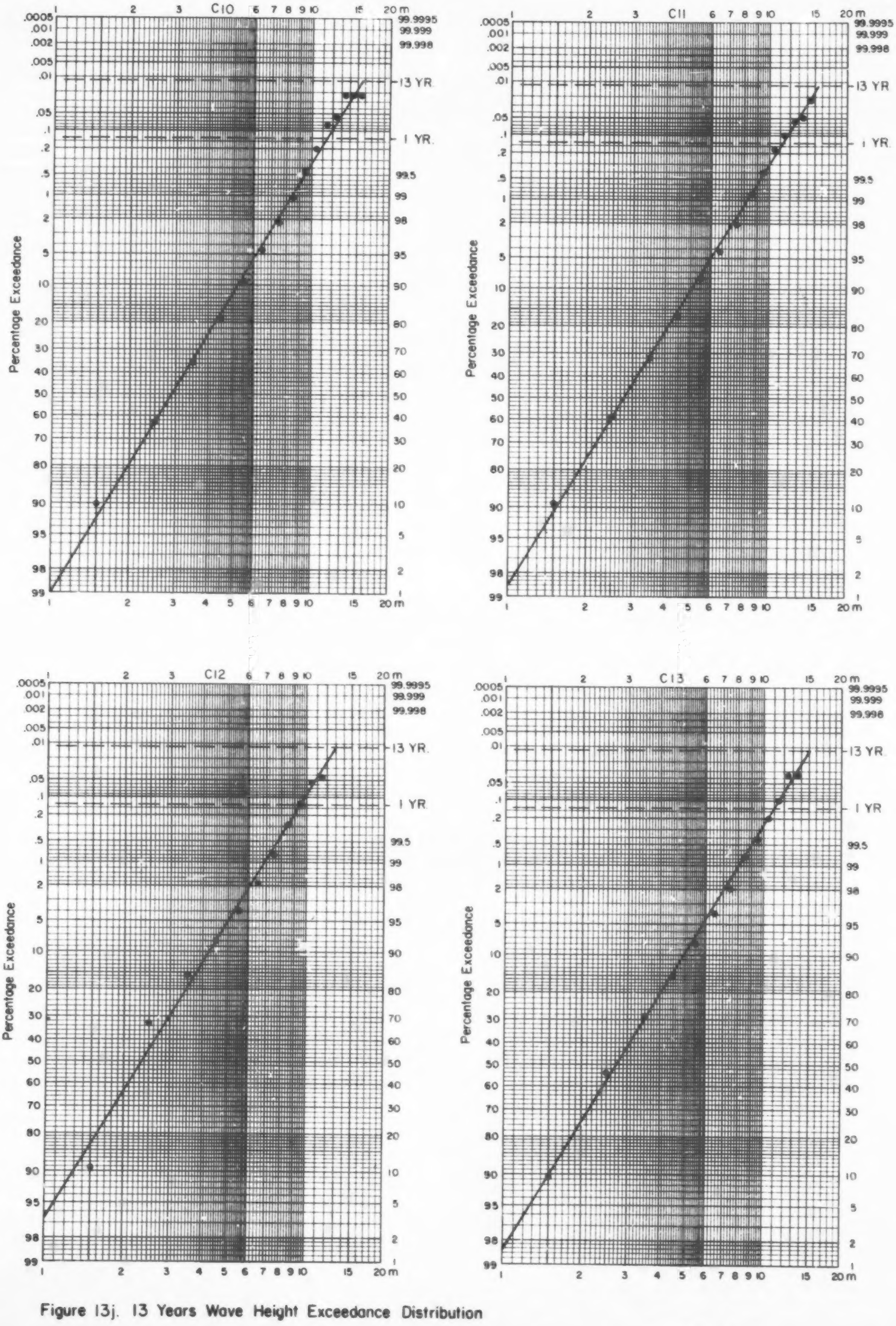


Figure 13j. 13 Years Wave Height Exceedance Distribution

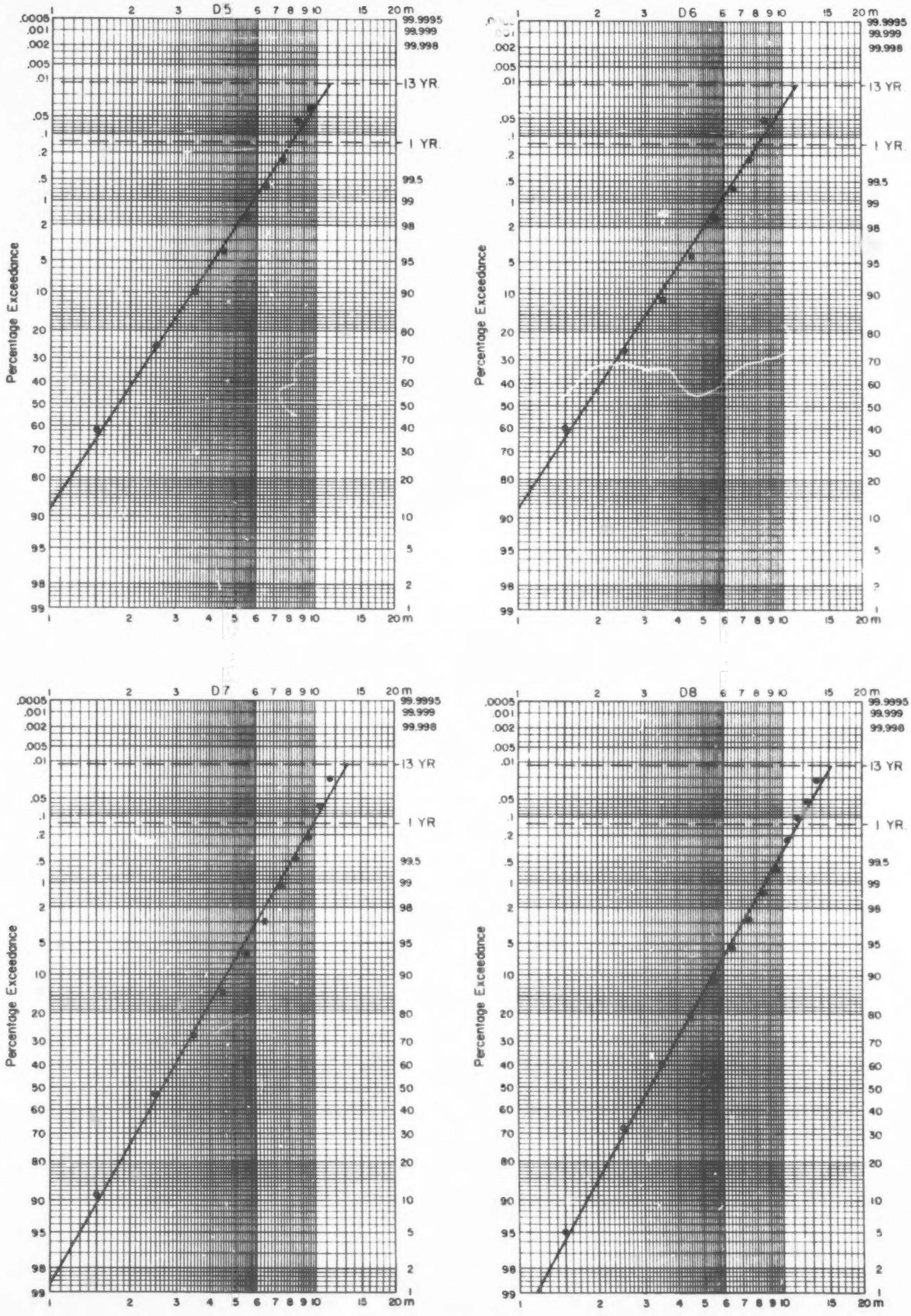


Figure 13k. 13 Years Wave Height Exceedance Distribution

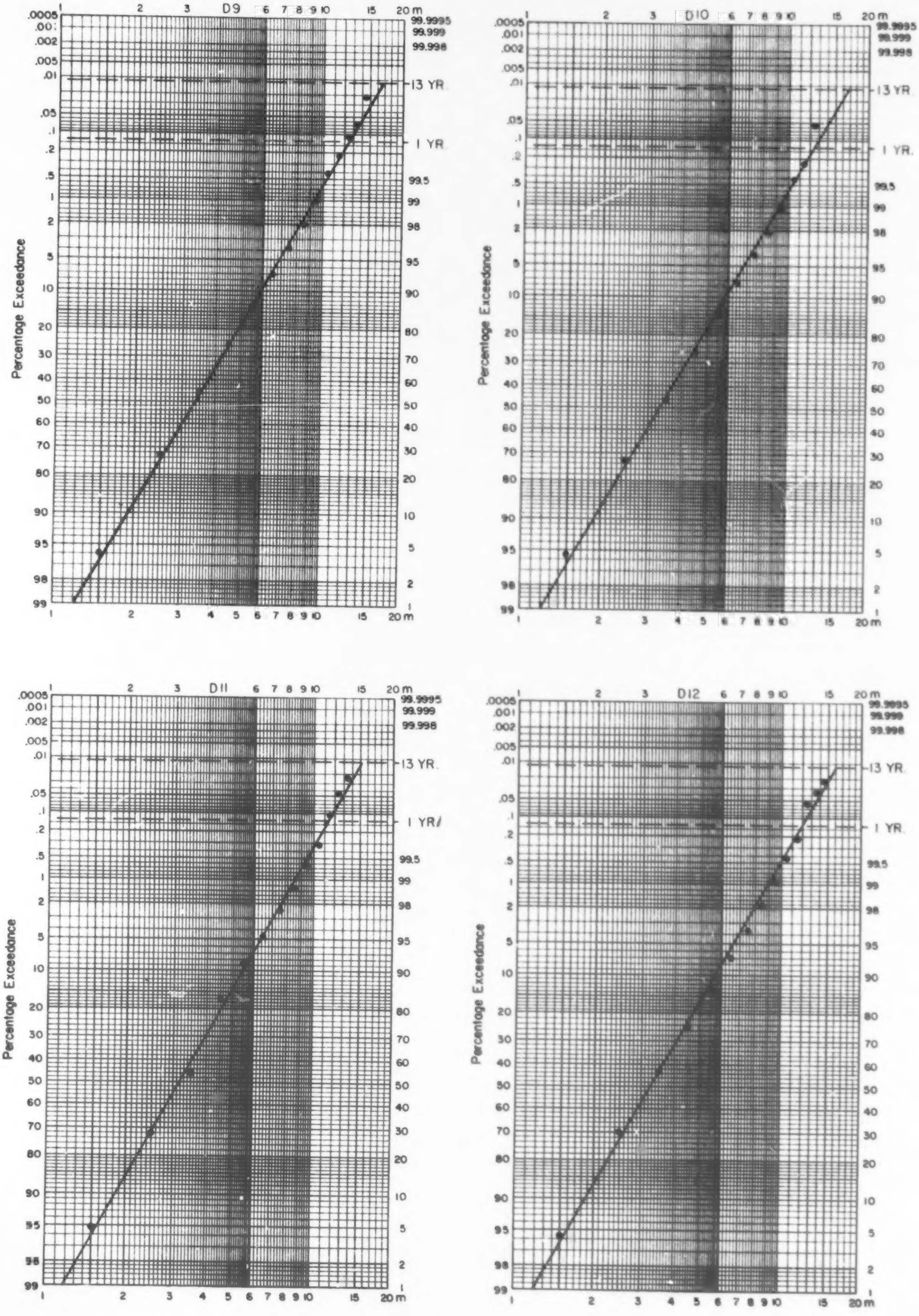


Figure 131. 13 Years Wave Height Exceedance Distribution

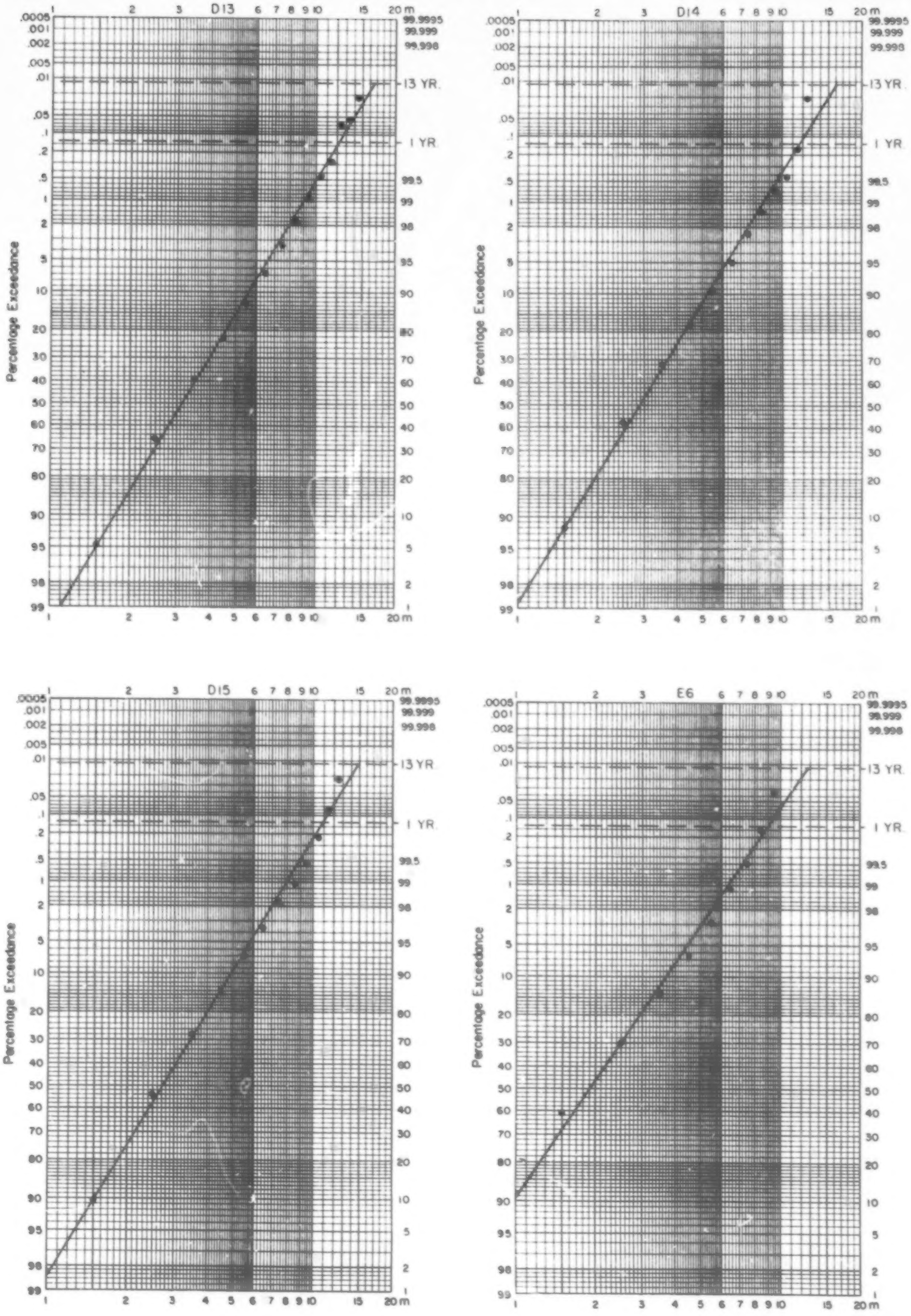


Figure 13m. 13 Years Wave Height Exceedance Distribution

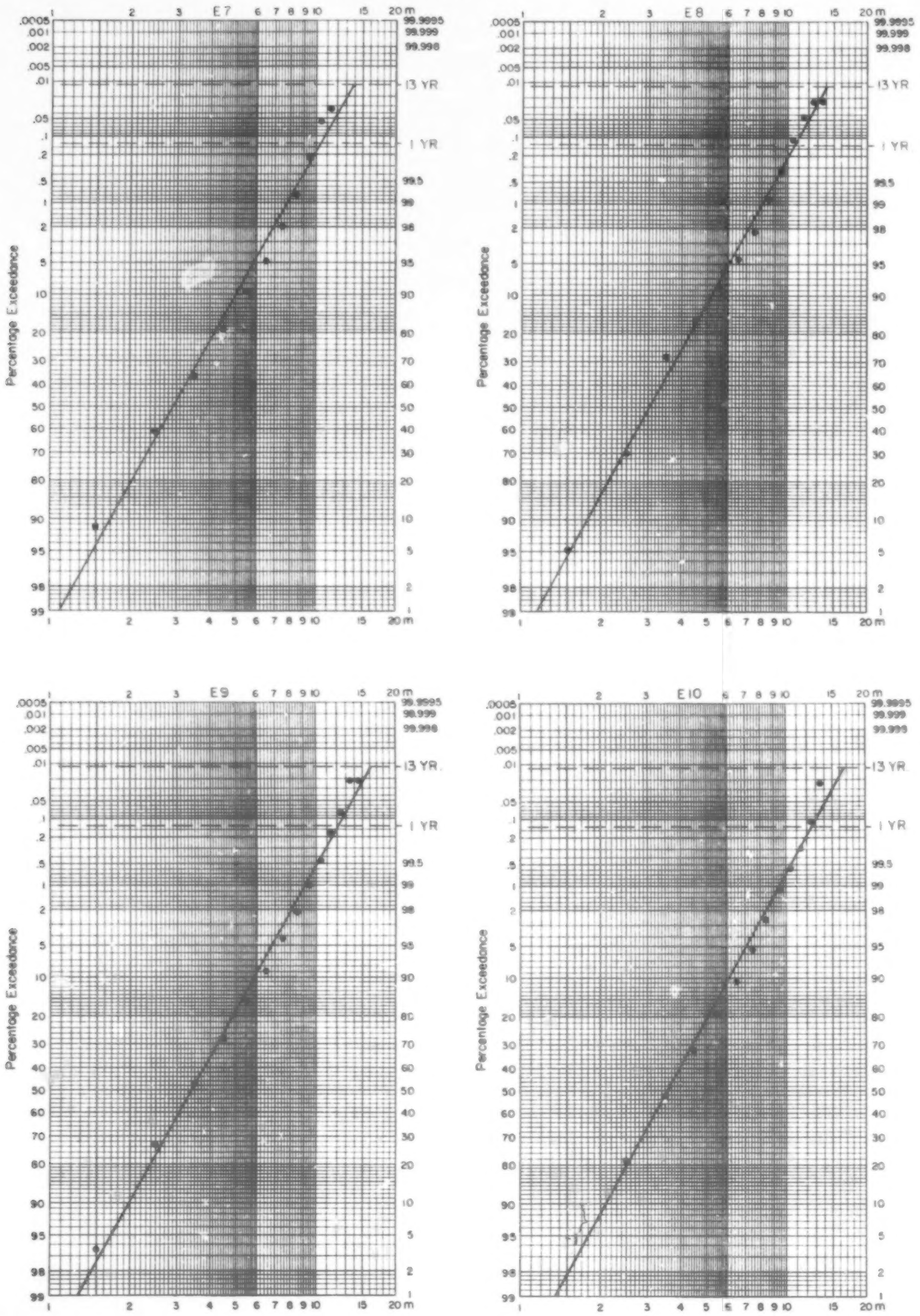
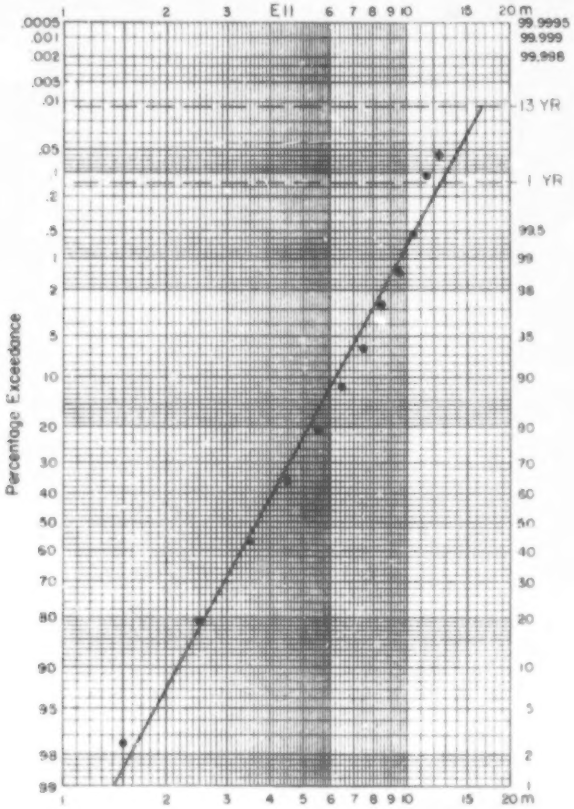
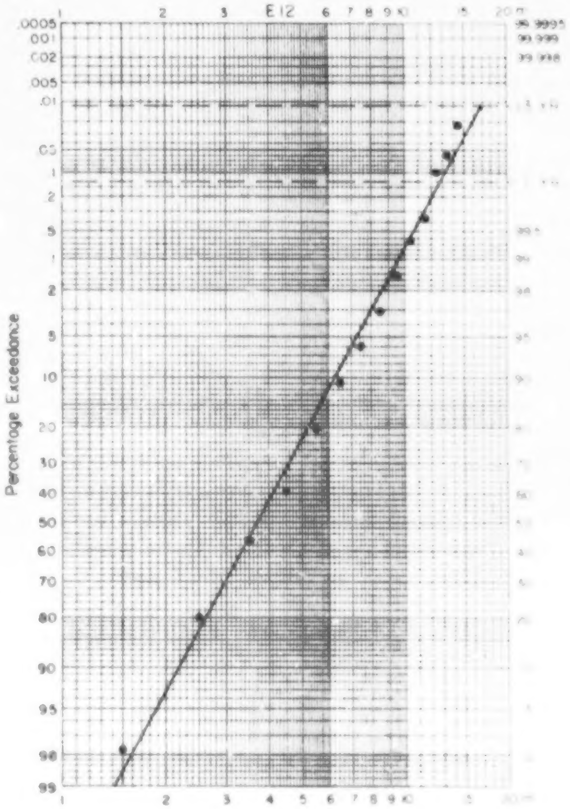
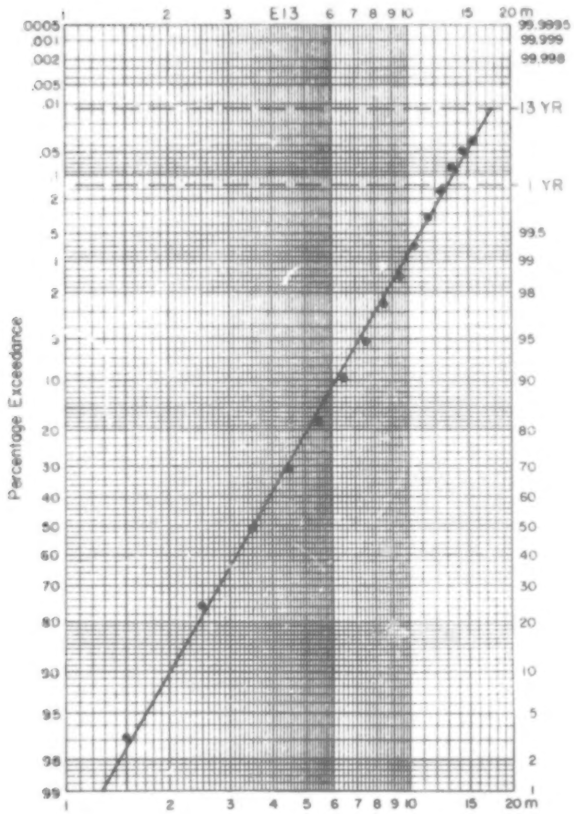


Figure 13n. 13 Years Wave Height Exceedance Distribution







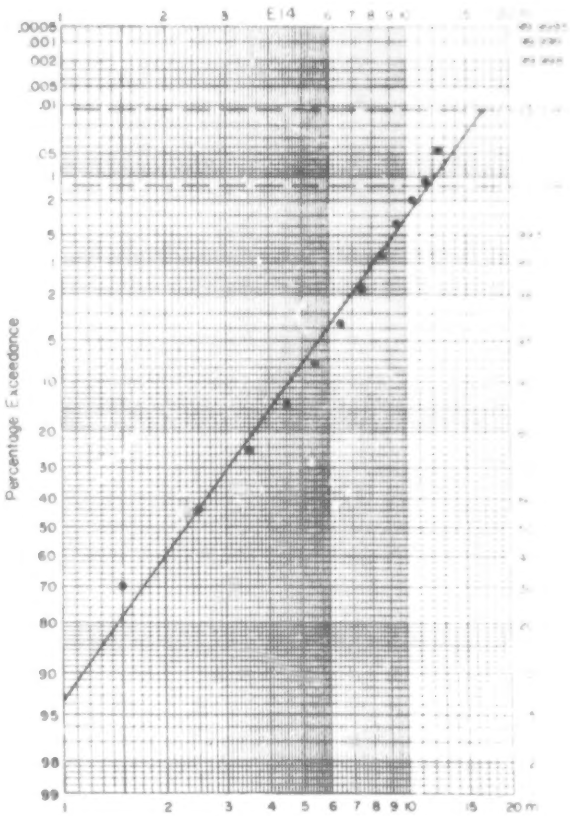


Figure 13o. 13 Years Wave Height Exceedance Distribution

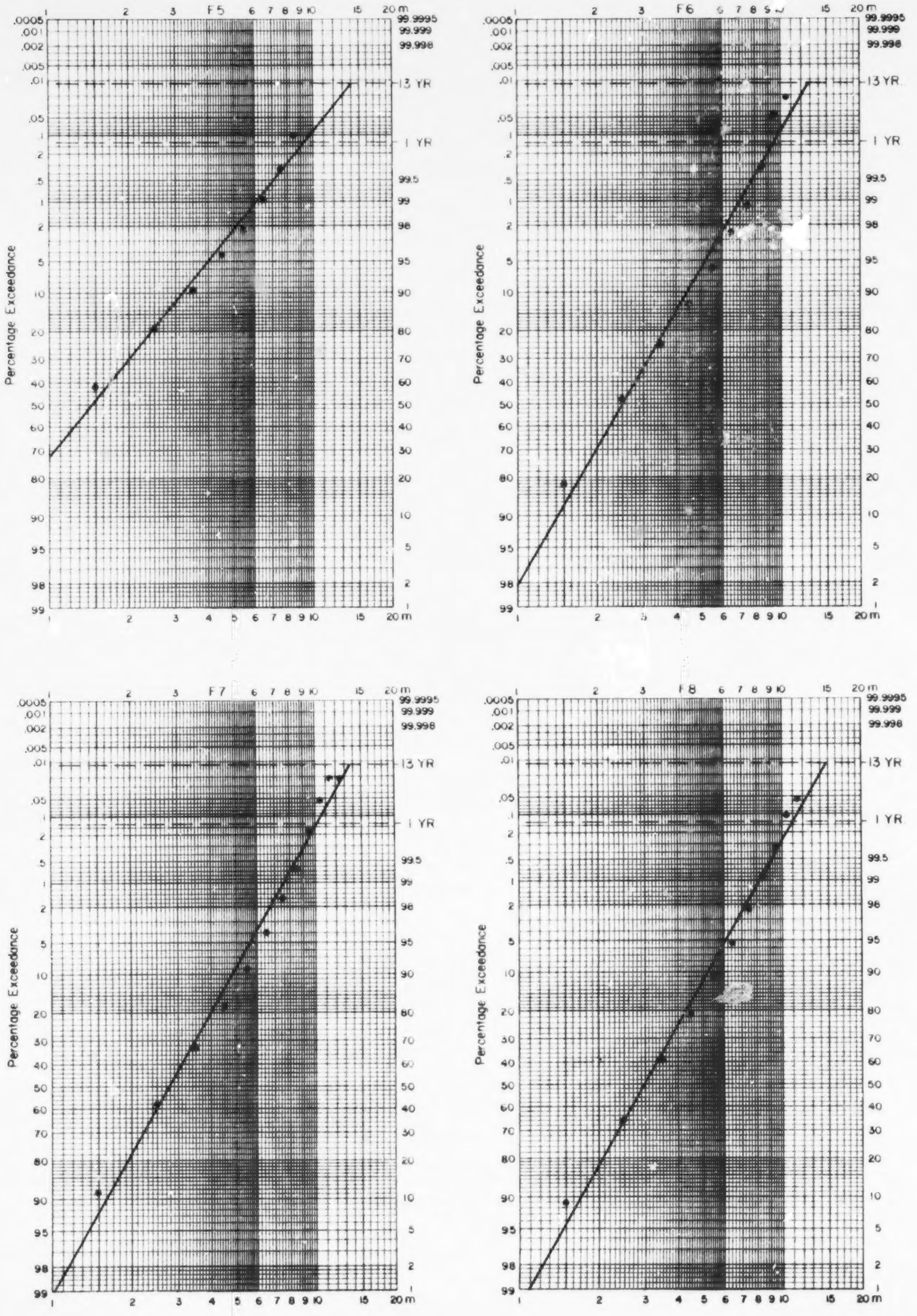


Figure 13p. 13 Years Wave Height Exceedance Distribution

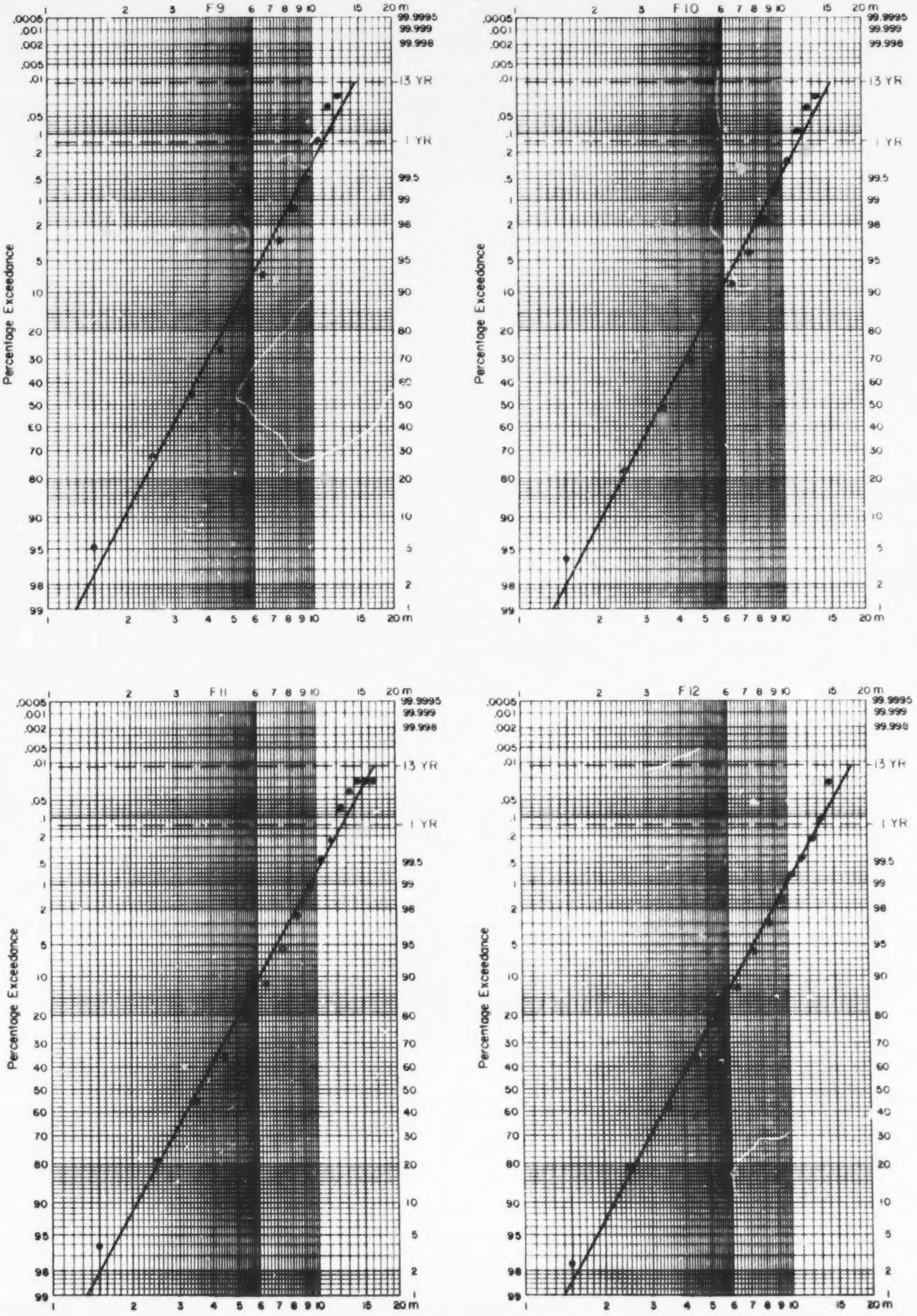


Figure 13q. 13 Years Wave Height Exceedance Distribution

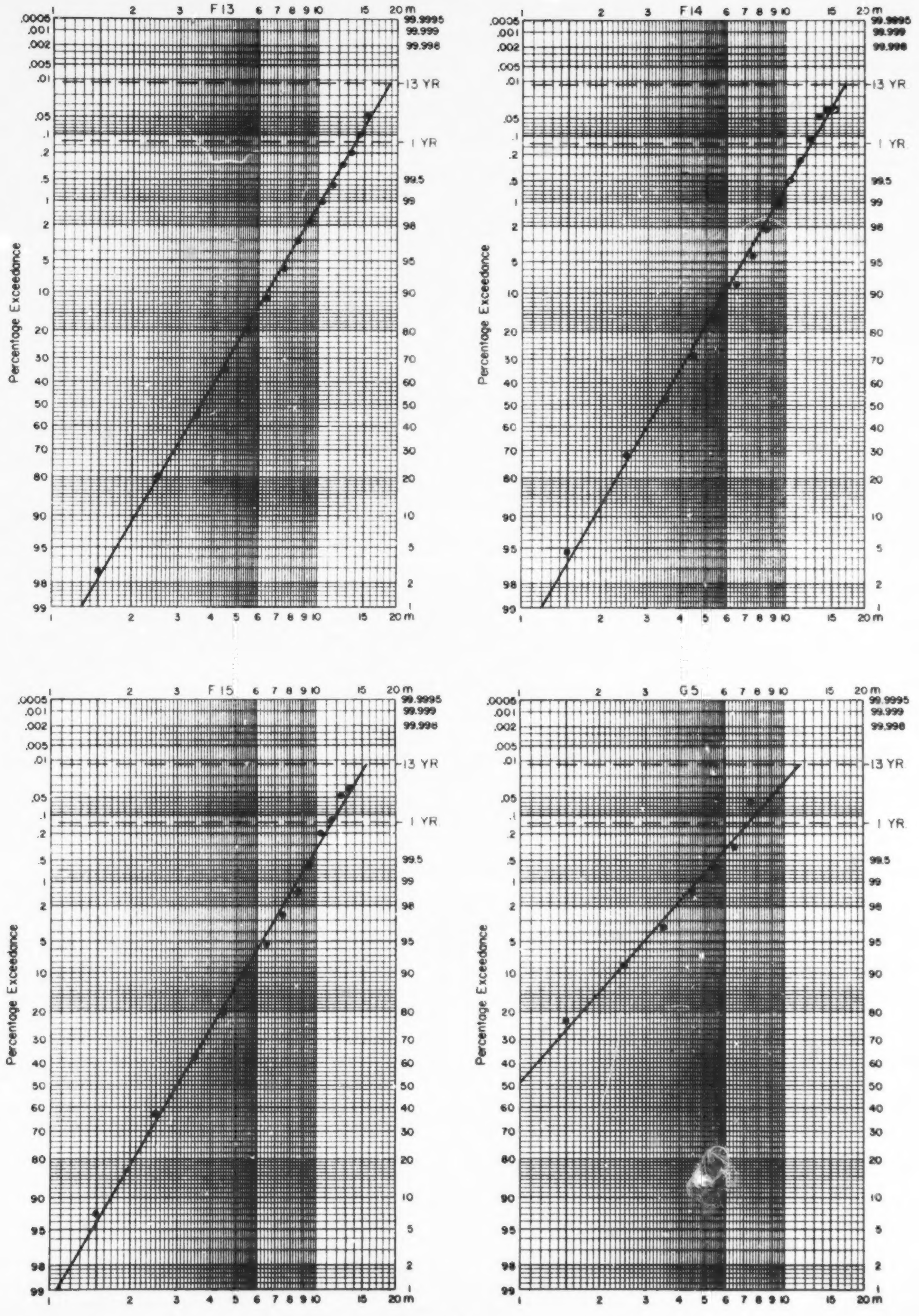


Figure 13r. 13 Years Wave Height Exceedance Distribution

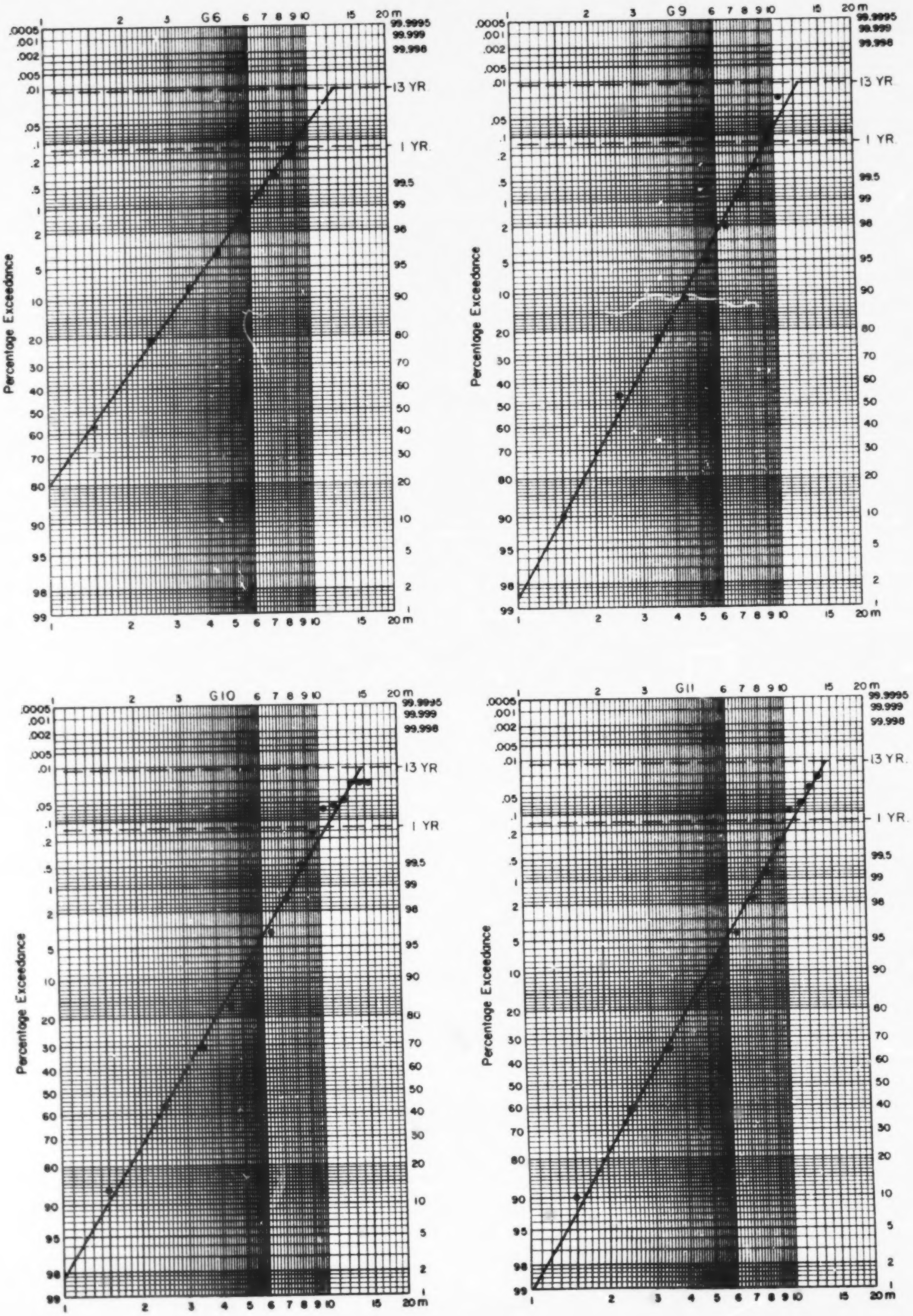


Figure 13s. 13 Years Wave Height Exceedance Distribution

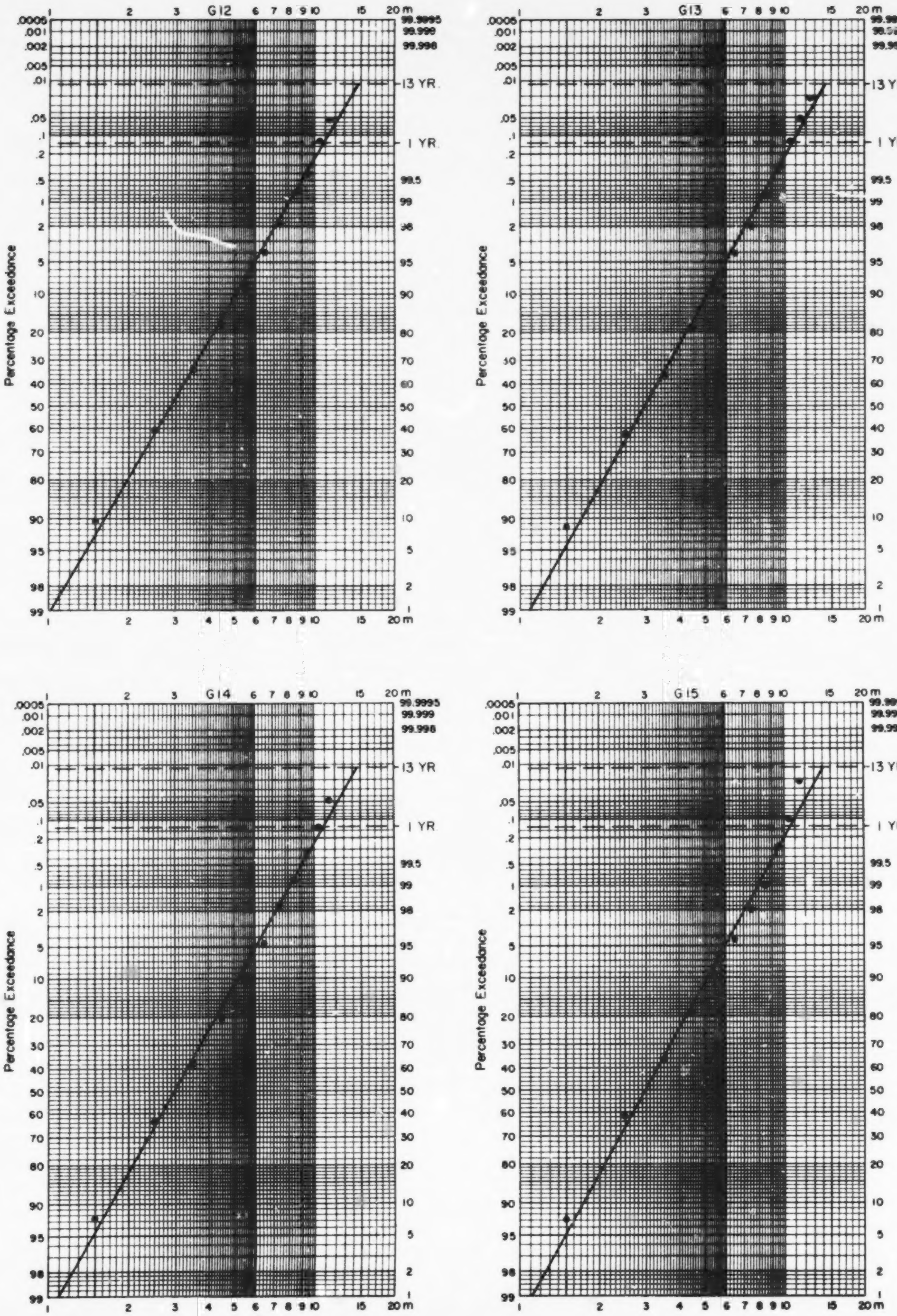


Figure 13t. 13 Years Wave Height Exceedance Distribution

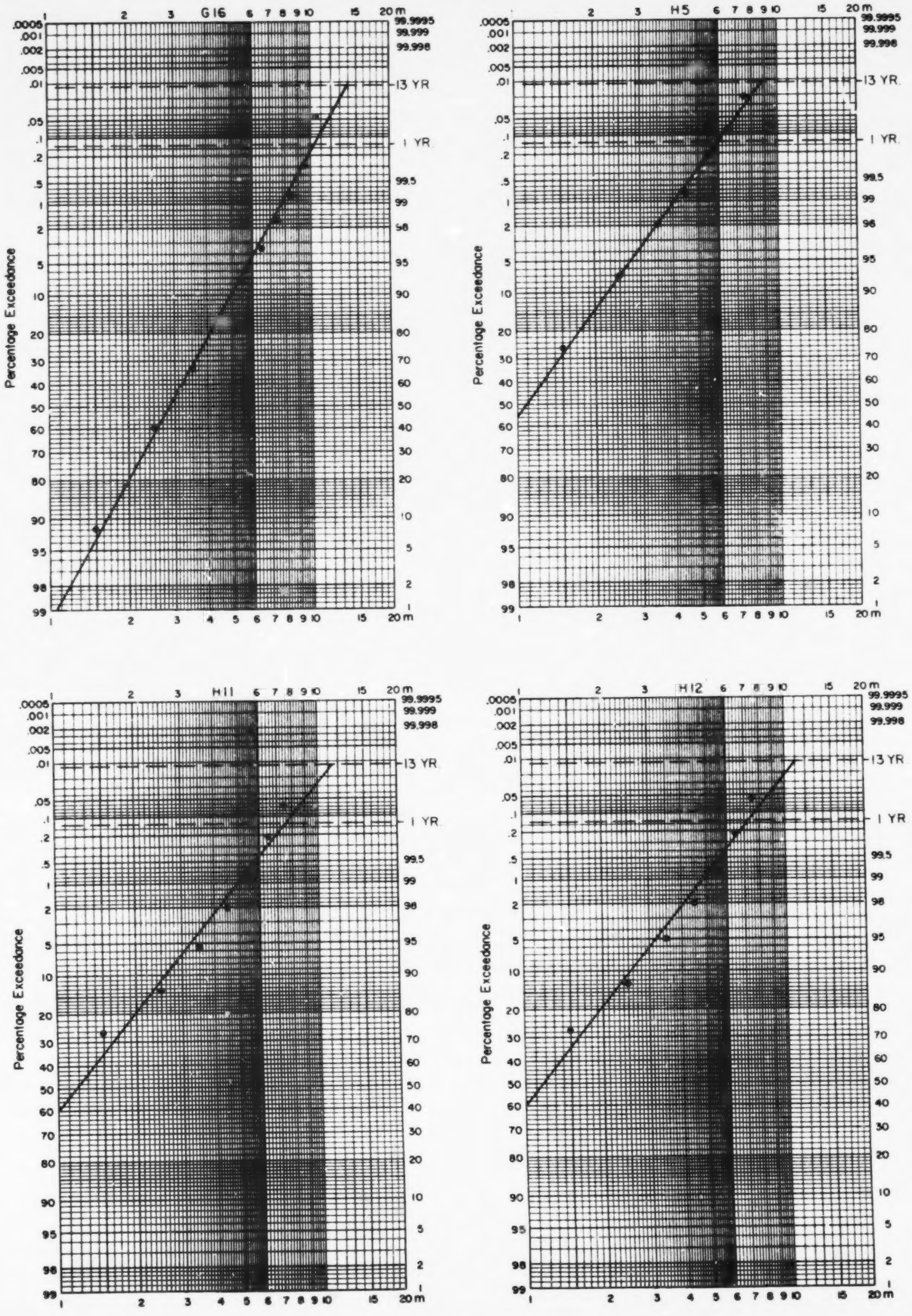
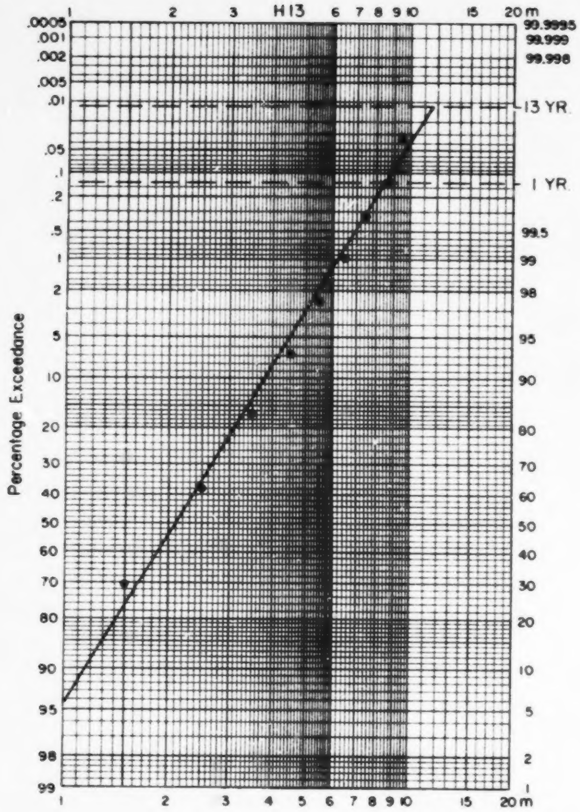
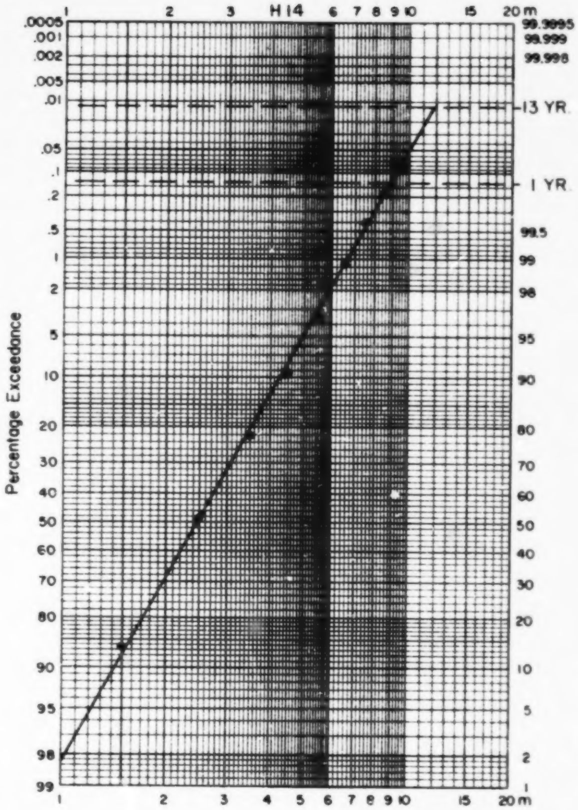
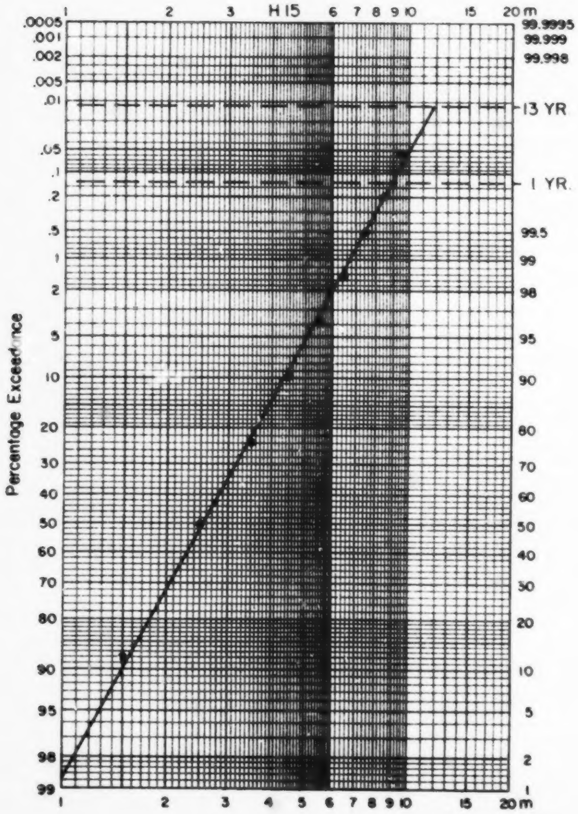


Figure 13u. 13 Years Wave Height Exceedance Distribution







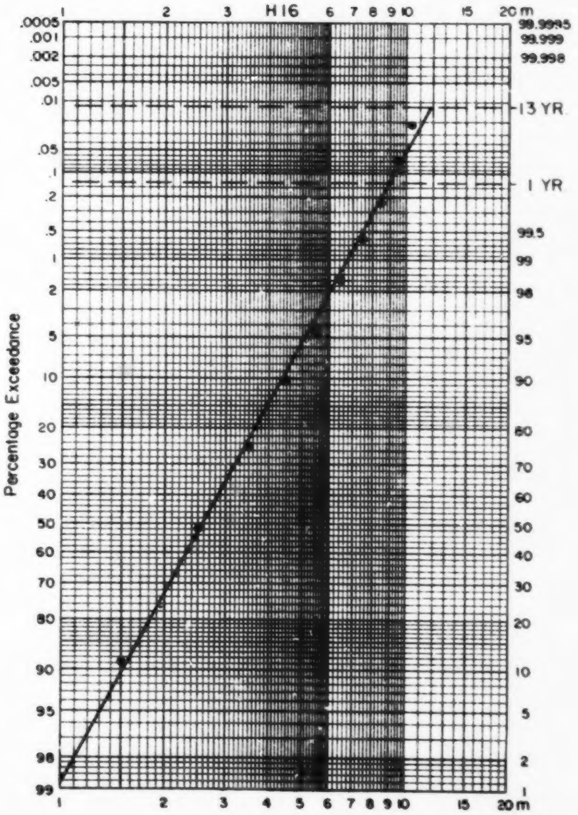


Figure 13v. 13 Years Wave Height Exceedance Distribution